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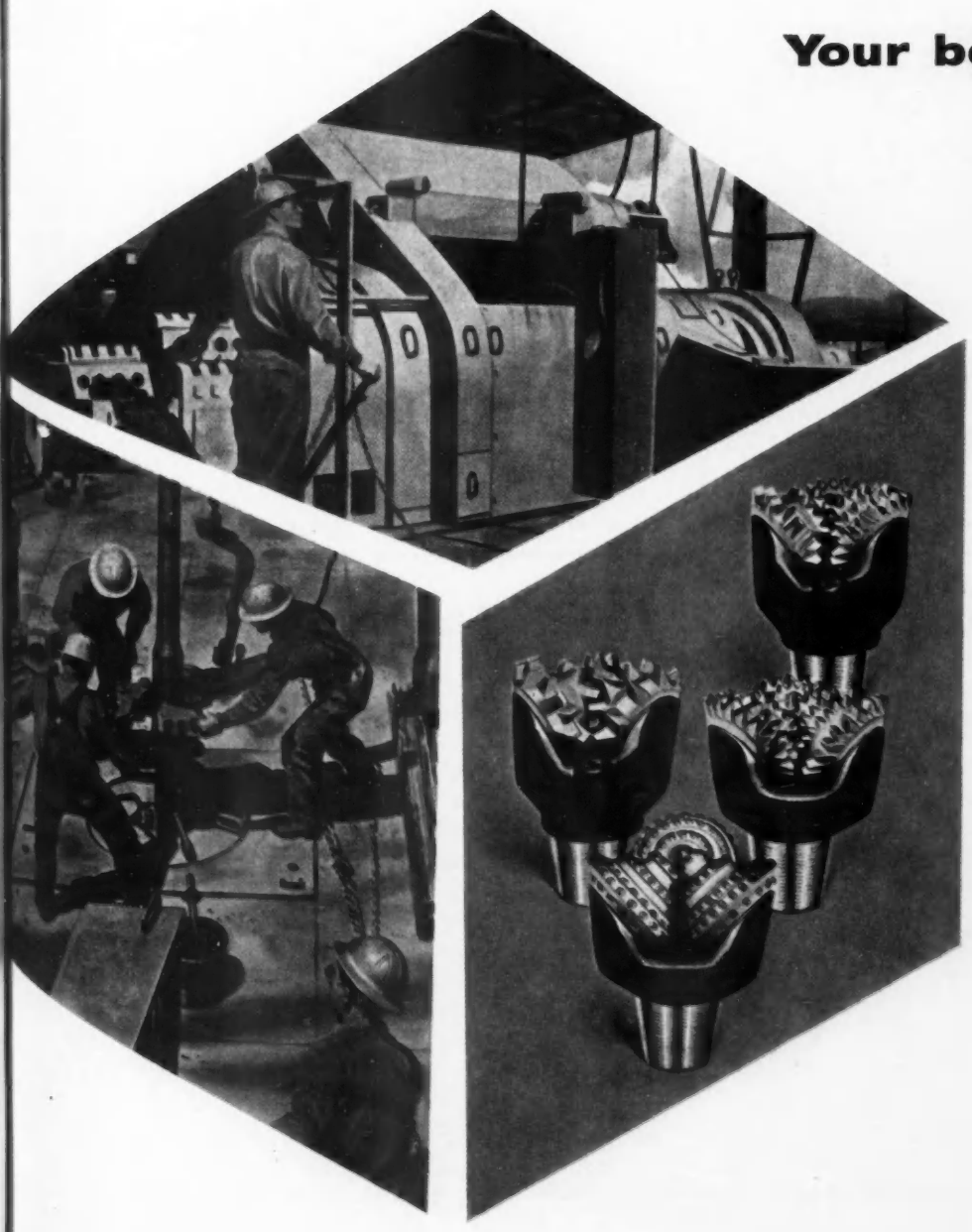

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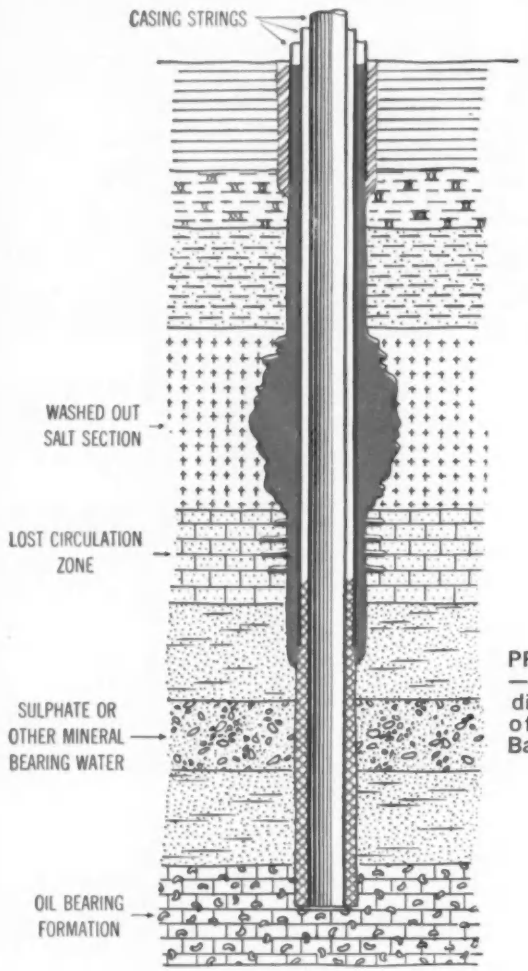
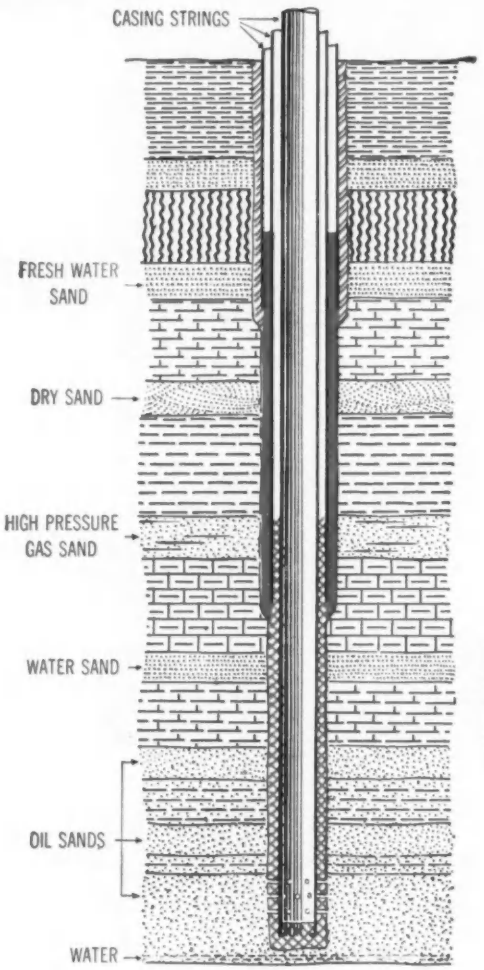


PROTECTION — under conditions typical of Permian Basin area.



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WORLD OIL

SPECIALIZED FOR EXPLORATION, DRILLING AND PRODUCING OPERATIONS AND MANAGEMENT

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Watch for World Oil's Forecast-Review Issue . . . February 15, 1959

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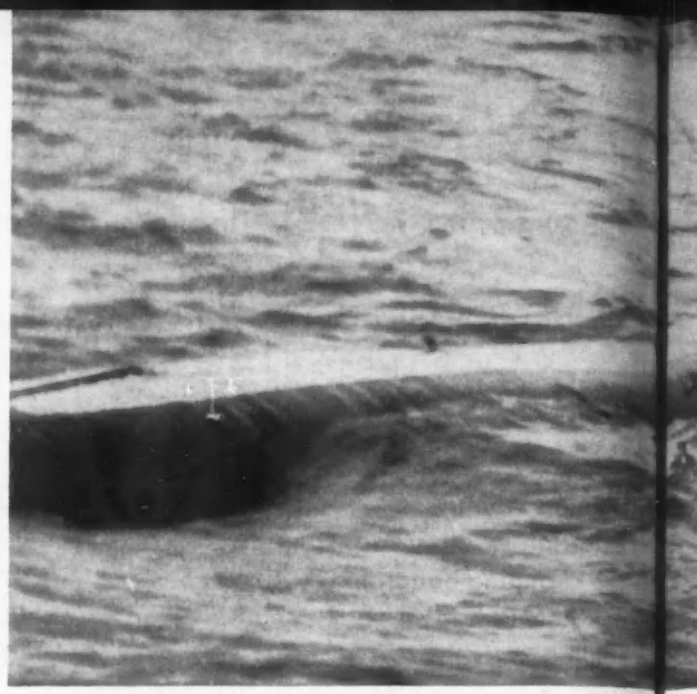
a *Quick Look* at WORLD OIL this month



BUSY OIL MEN: To help you put first things first, scan these time-saving digests on this and the following pages, checking ☑ those you want to read first

☐ **U.S. prices for both crude oil and refined products** continue weak and unstable, despite substantial inventory improvement in recent months. Stocks of gasoline, distillate fuel and crude oil have fallen below year ago levels, as rising refined product imports only supply factor not held to current needs. Chief cause for price weakness in view of this generally favorable economic position is an intensive battle for gasoline sales. Lower retail price have forced refinery prices downward, which in turn have led to crude oil price cuts. Unfortunately, prospects for correction of this situation are not bright. . . . . **Page 25**

☐ **Time-cycle intermitters, plunger-lifts boost output in the San Juan Basin** . . . With more than 3,400 producing gas wells in the San Juan Basin, operators are concerned with the most efficient and economical production methods available. This article discusses problems associated with natural gas production in the area as well as various corrective methods used to overcome them. . . . . **Page 101**

☐ **Additional mud storage for offshore rig at nominal cost** . . . Kerr McGee Oil Industries, Inc., recently converted an integral portion of its

Once-in-a-Lifetime

WHEN IT BECOMES a Centenarian in 1959, the Oil Industry can look back on its eventful past with justifiable pride.

For 100 years oil has been the backbone of the Industrial Age. No industry has contributed more to this century of greatly improved living standards, made greater technological progress or had a more colorful history.

WORLD OIL's Century of Oil Issue will be published January 1 to commemorate the beginning of the oil industry's Centennial observance. However, this is not an ordinary history. It is an attractively illustrated review (with 100 artists' sketches) which stresses the technological growth of the industry. The economic growth and political history of oil is also presented in detail. This Centennial report has resulted from thousands of man-hours of research and writing, plus consultation with scores of top industry authorities.

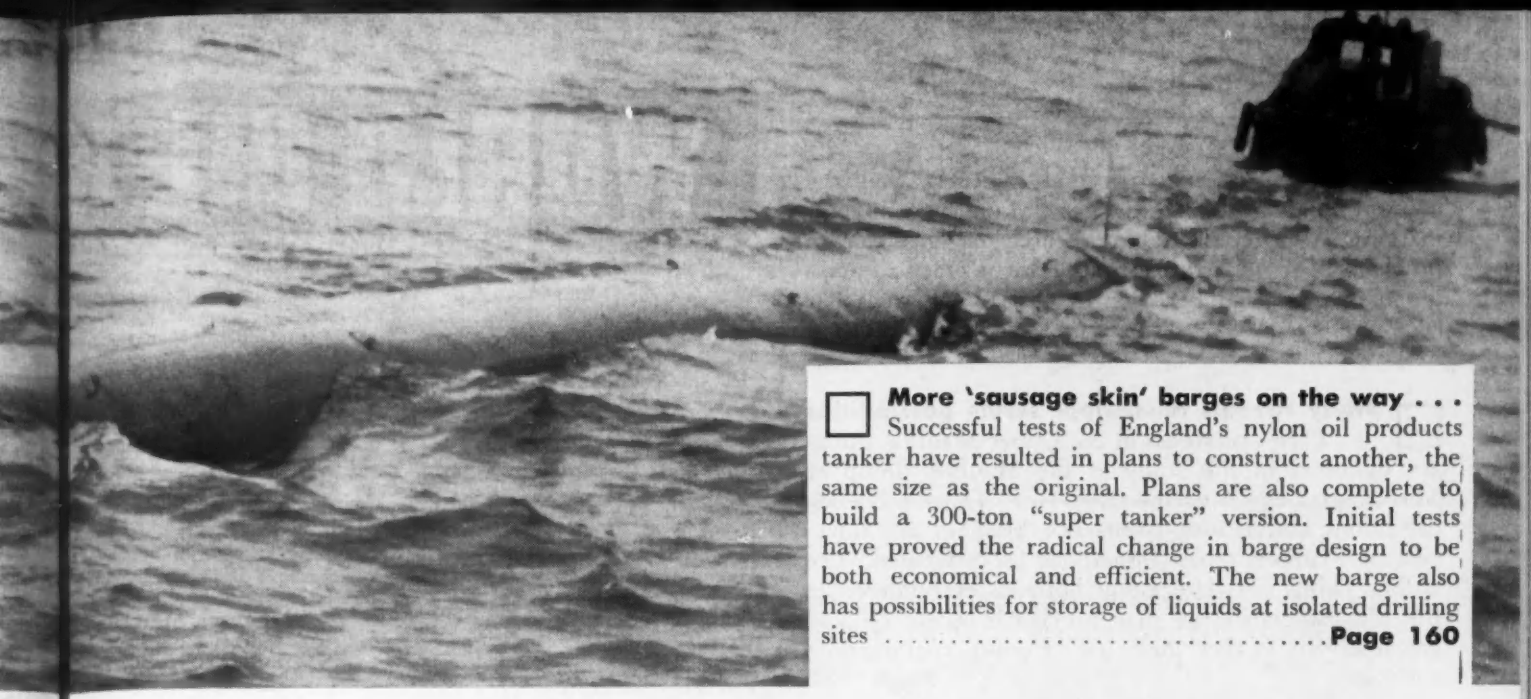
Following is a brief outline of what you will be reading in your January issue:

• **General.** Growing need for oil and gas; their contributions to civilization . . . the change from an era of chaos and waste to efficiency and conservation . . . growth of competition . . . history of prices, taxes, state and federal regulations, annual demand, expansion overseas, imports, and exports.

• **Exploration.** Progress from divining rods and creekology to a highly respected science . . . contributions to industry growth . . . history of reserves . . . milestones in methods and equipment, including non-geologic prospecting, surface geology, subsurface geology, well samples and logs, geophysics, aerial photography.

• **Drilling.** How man's ingenuity, spurred on by competition, developed methods and equipment to drill hole faster, cheaper and deeper—making available enough oil to keep it among the cheapest of all commodities during an era of skyrocketing demand . . . chronological development of methods and equipment that made this progress possible.

• **Detection of presence.** Advances in coring, electric logging and other methods which overcame early rotary handicaps, and made possible the detection of thin lens pay zones.



☐ **More 'sausage skin' barges on the way . . .** Successful tests of England's nylon oil products tanker have resulted in plans to construct another, the same size as the original. Plans are also complete to build a 300-ton "super tanker" version. Initial tests have proved the radical change in barge design to be both economical and efficient. The new barge also has possibilities for storage of liquids at isolated drilling sites ..... **Page 160**

Rig No. 46 to a 500-barrel capacity reserve mud pit. The unique conversion job was accomplished on location for approximately $12,000. For the story of this unusual operation, turn to..... **Page 105**

☐ **Intermittent gas lift operation is successful for two-string duals** . . . Here are the latest equipment considerations and techniques applied to intermittent gas lift of parallel string and dual completions. Excellent results have been obtained in West Texas by applying the methods discussed in the article beginning on..... **Page 108**

• **Well completion.** A complete history of this vital part of the oil industry from open hole to gun perforated, to multiple wells and permanent completion methods, including cementing's role.

• **Production.** Chronological review of developments that have made it possible to recover oil in greater quantities at lower cost, including a well illustrated history of wellhead control, artificial lift, well stimulation, oil-gas separation, treating, lease automation, pressure maintenance, and secondary recovery.

It has been a once-in-a-lifetime opportunity for the WORLD OIL staff to prepare this Century of Oil Issue. And we are certain that, for reading interest and future reference, this special issue will be a once-in-a-lifetime experience for our readers.

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☐ **How a Canadian operator uses chemical control of H_2S during drillstem tests . . .** Chemical control of hydrogen sulfide gas has proved effective in Canadian operations. Ammonium hydroxide is used to protect rig crews from toxic effects of the gas. For a complete description of the methods used by one company, see..... **Page 111**

☐ **Are diesel-electric rigs performing properly?** . . . They are showing continued improvement through the joint efforts of drilling contractors and electrical equipment manufacturers. A complete evaluation was undertaken on the electrical equipment on Great Western Drilling Company's diesel-electric rig operating in West Texas. For the results, see **Page 113**

☐ **How bankers evaluate oil-producing properties** . . . Three methods of financing the purchase of producing properties are outlined in this article. Whether you obtain property by cash purchase, direct loan, or the use of an oil payment, the lender as well as the operator must consider the effect these various methods will have on the net cash income and the present worth of oil in the ground..... **Page 119**

☐ **Natural gas prospects good in South Texas' Wilcox Trend** . . . The Wilcox Trend includes 193 fields producing from Wilcox reservoirs. Although the area presents geologic and engineering problems, prudent operators can expect better than average success ratios. Current activity indicates there still is gas to be discovered in the trend area.... **Page 123**

☐ **Temperature logs aid gas storage well analysis** . . . Temperature logs can help reservoir engineers concerned with storage problems, particularly as gas storage becomes more widespread and more sensitive temperature recording devices are developed and put into use. New quantitative and qualitative analytical techniques have been developed to establish temperature conditions as a function of

the rates of gas production and injection, and the exchange of heat between the gas and underground formations. After considerable research on gas storage problems in the Appalachian province, a practical analysis of the thermal behavior of gas storage wells has been presented **Page 128**

☐ **Study reveals Mississippi series possibilities** . . . Facies problems in the Upper Madison group are discussed in this study of the Madison group of Mississippian age in northwestern North Dakota. Names, definitions, correlations, occurrence, lithology and thickness of Madison group formations are presented. The author points out that porous horizons encountered in the Mississippian series may provide excellent oil and gas reservoirs if they meet one or more combinations outlined **Page 136**

☐ **How to detect and control corrosion-causing bacteria** . . . Bacterial corrosion control is effective when the actual cause of the corrosion is known. The environment and processes involved are brought out in this article. The chemical reactions necessary to promote corrosion by bacteria and the substances and methods that aid in restraining bacterial growth are explained **Page 144**

☐ **Deep drilling and extensions may increase potential of Nesson Anticline area** . . . Within seven years, North Dakota has been transformed from a non-oil state to a 13 million-barrel-a-year producer—mainly because of the Nesson Anticline. And predictions are that the area's present 75-mile north-south limits may be extended to 100 miles. For an authoritative review of the Williston Basin's outstanding geological structure including present activity, trends, plus a detailed report on drilling and completion programs in the area, turn to **Page 148**

☐ **Earnings begin to improve following year of decline** . . . Almost all oil companies reported better earnings for the third quarter of 1958 than for the second quarter. The performance represents a reversal of the downward trend which had been underway for a year. Third quarter earnings are still somewhat short of those in 1957. But in the fourth quarter of 1958, an improvement over 1957 is in prospect **Page 159**

☐ **New fields boost Canada's natural gas reserves** . . . New discoveries and extensions during 1958 have increased Canada's recoverable natural gas reserves to more than 25 trillion cubic feet. With the Yukon and Northwest territories still relatively unexplored, predictions are that the ultimate total will exceed 250 trillion cubic feet. For a highly informative discussion for the reasons behind this prediction, turn to **Page 162**

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PIPE LINE INDUSTRY and THE PIPE LINE COMPOSITE CATALOG for the oil and gas pipe line industry.

Indexed by Industrial Arts Index and Engineering Index

Looking Ahead

Drilling Activity Continues Steady Increase . . . Total rotary and cable tool rigs operating at year's end are expected to show usual increase over previous months, but will still be under November-December acivity of recent years. On October 31, an estimated 4,286 rigs were operating in the U.S., continuing a steady five-month climb from 3,938 rigs reported on May 31. (See Page 28.)

WORLD OIL'S **mid-year forecast** of 47,952 well completions in '58 will be close to the mark. New completions for first ten months totaled 39,981, averaging more than 4,000 wells in each of past four months. Indications are total will go slightly over 48,000 completions at year's end. Completions for first ten months were 10.9 percent (4,890 wells) under same months in '57.

Upswing in Equipment Spending During '59 . . . Look for oil company spending to regain momentum in '59. Southwest Purchaser reports 30 companies expect to spend more than $500 million for materials, supplies and equipment. Forty-nine of 52 companies surveyed expect to make more purchases in '59 than in '58.

Company Earnings Show Improvement . . . Oil industry will pull itself a little farther out of recession doldrums during last three months of '58. Earnings are expected to equal or exceed third quarter, with increased winter volume outweighing weakened price structures of recent months. (See Page 159.)

Although third quarter earnings of 48 oil companies improved considerably over second quarter, total profits for first nine months of '58 were down 25.4 percent from same '57 period. Compared with '57, quarterly earnings for '58 were down 33 percent in first three months, 38 percent in second and only 2 percent in the third.

50,000-foot Wells by '75? . . . Within 17 years oil wells will be drilled up to 10 miles deep, costing in excess of $5 million each, Atlantic Refining engineer R. O. Childers predicts. He says there is reasonable certainty that crude reserves could be upped 30 percent and gas reserves 70 percent from such depths. There is one major "if" in the prediction: Several major equipment problems will have to be solved first.

Another Atlantic Refining engineer, S. H. Davis, says major drawback in drilling to depths below 10,000 feet is cost. In addition to developing more efficient and cheaper ways to drill deep wells, the major challenge facing today's engineers is to find a more effective way to detect pipe imperfections. Pipe collapse becomes a major expense problem at greater depths. He estimates that 40-60 percent of present deep well drilling expense (below 10,000 feet) is for pipe.

Continued on next page . . .

Multiple Completions Without Tubing . . . Humble Oil came up with another industry "first" last month, making two tubingless triple and two dual completions in the Raccoon (Texas) field. Each well was completed through a clamped-together bundle of independently hung strings of 2⅞-inch casing. Wells range from 1,800 to 3,800 feet in depth.

Company spokesmen report cost of completions was about 50 percent less than drilling separate wells to three reservoirs. Major factor in success of new development is positioning device that prevents perforating guns run in one casing from shooting holes in the others.

Western Canada Gas Reserves May Exceed 250 Trillion Cubic Feet . . . Recent discoveries have boosted Western Canada's recoverable natural gas reserves to more than 25 trillion cubic feet—and recent studies indicate ultimate total may exceed 10 times that amount. (See Page 162.) Huge potential is within 700,000-mile area of Sedimentary Basin, including all of Alberta, parts of Saskatchewan, Manitoba and Yukon territory.

Green County, Kentucky—An Independent's "Paradise" . . . Independent operators are making hole at a record pace in Kentucky's new Greensburg pool. From a daily production of 600 barrels per day in 1957, the area now is producing 10,000-14,000 barrels daily from Devonian-Silurian formations at 300-600 feet. Ten wells per day are being completed, with about 100 rigs (mostly cable tool spudders) working the field. More than 600 wells had been completed by mid-November, with an 80 percent success ratio.

"Flame-Flooding" Project Scheduled for Wyoming . . . Continental Oil Company will conduct large-scale in situ combustion pilot test in consolidated sands of Wyoming's North Tisdale field. If experiment succeeds, thermal drive will be used throughout the 160-acre reservoir.

An earlier, small scale project succeeded in establishing air circulation between a central injection point and five producing wells, then an oil well heater was used to "ignite" the oil, setting up combustion front that resulted in appreciable increase in oil production. Two 440-horsepower packaged units were used to set up air circulation.

Elections Cloud Oil's Outlook for '59 . . . Democratic sweep in House of Representatives has reduced hope that natural gas amendment will be enacted next year, may also brew major storm over 27.5 percent depletion provision. Many of the new congressmen were financed largely through labor contribution to their campaigns—and some may be expected to adopt dogma of "consumer protection" through strict FPC control.

Borden Commission report . . . a serious setback for Canada

A serious blow has been dealt Western Canada gas producers and pipe line companies. Any hopes they might have entertained for early permission to export natural gas has been dispelled as a result of the first report of the Royal Commission on Energy, commonly called the Borden Commission.

The report recommends the establishment of a five-man National Energy Board, which would have sweeping power over oil and gas. Some idea of the proposed scope of the board's authority can be gleamed from the following:

"That the National Energy Board shall have authority to study, review and from time to time recommend to the Minister of Trade and Commerce such policies and measures as it considers necessary or advisable in the public interest for the control, supervision, conservation, use and development of energy and sources of energy and for the production, recovery, manufacture, processing, distribution, transmission, sale, purchase, exchange, disposal, import or export of energy and sources of energy within, to or from Canada."

In view of the foregoing, little comfort is provided by the declaration that exports of Canadian natural gas on a moderate scale are a "highly desirable step," and that it would be unfair to producers to require that "proven reserves be set aside for all long-term future needs of Canada."

This means a long delay before any action can be expected on the granting of export permits. Establishment of such a regulatory body means government study before passing enabling legislation. This could take a year. Then, before the new board could grant export licenses, it would have to review each case on its individual merits. This means another long delay.

Furthermore, since the only possible gas export market is the United States, all applications would have to be aired before the U. S. Federal Power Commission. Here is another delay, and U. S. producers will tell you it means a long delay.

Hopes of producers and pipe line companies that they might gain gas markets through exports of Trans-Canada Pipe Lines Limited also has been dashed by the report. The commission has recommended that the permit promised Trans-Canada in a letter dated September 28, 1955, by the then Minister of Trade and Commerce, for gas export to Tennessee Gas Transmission for resale in the U. S., be "stricken and be considered no longer of any effect." In this connection, the commission recommended that any future application of Trans-Canada for an export license "be considered on its own merits."

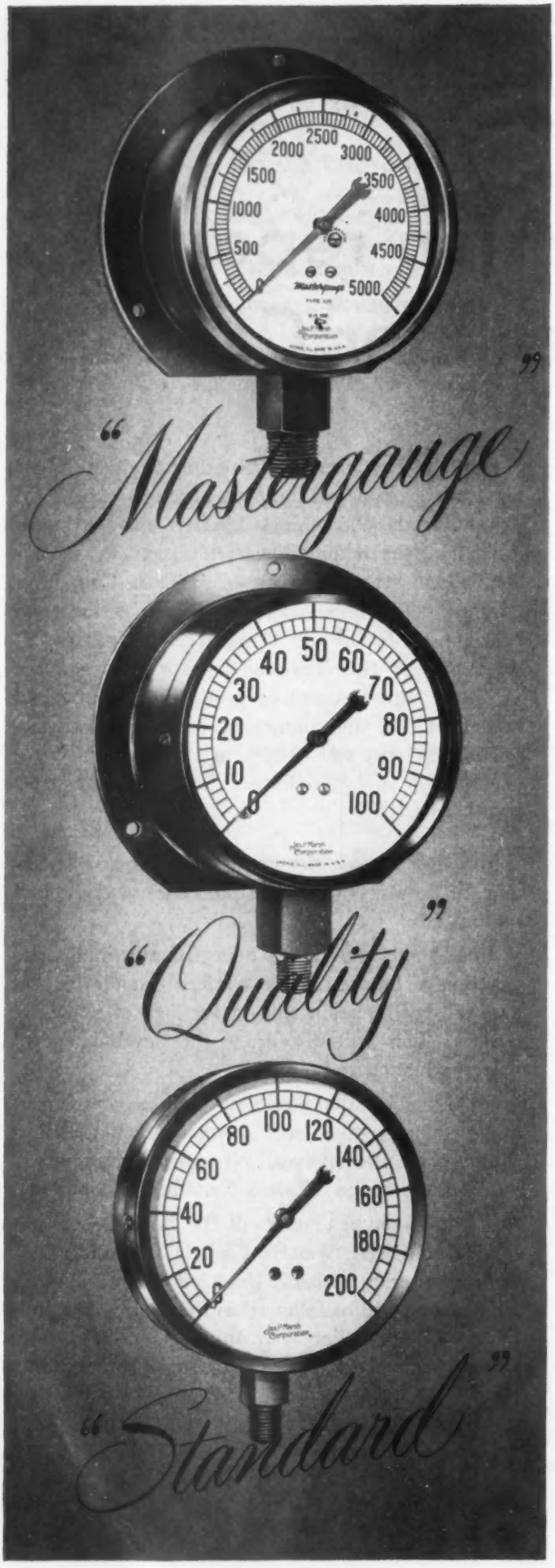
This action makes the outlook in Canada uncertain for both producers and pipe lines of crude and natural gas.

Since there can be no hope for any immediate granting of licenses, many Western Canada oil and gas wells will remain shut-in for lack of a market outlook. This will discourage the development of both production and pipe lines.

Furthermore, the possibility that a government agency may be given such sweeping regulatory authority over practically all oil and gas matters will tend to discourage Western Canada development.

If the recommendations of the Borden Commission are followed, Western Canada operations have received a serious setback. Until it is definitely known what course will be followed in the future, both producers and pipe line companies will proceed with caution. This will have a detrimental effect on Canada's supply of oil and gas. By the time conditions are stabilized, Canada may lose some of its oil and gas markets.

Warren L. Baker



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"THE STANDARD OF ACCURACY"

Warren L. Baker, Editorial Director

Prices fail to respond to improved stocks

Battle for gasoline sales keep prices weak and unstable, although inventories are in best position in years as all supply but refined products imports held to current needs

U. S. oil prices are not being established by supply and demand today. If they were, prices would be firm and perhaps higher instead of weak and tending downward.

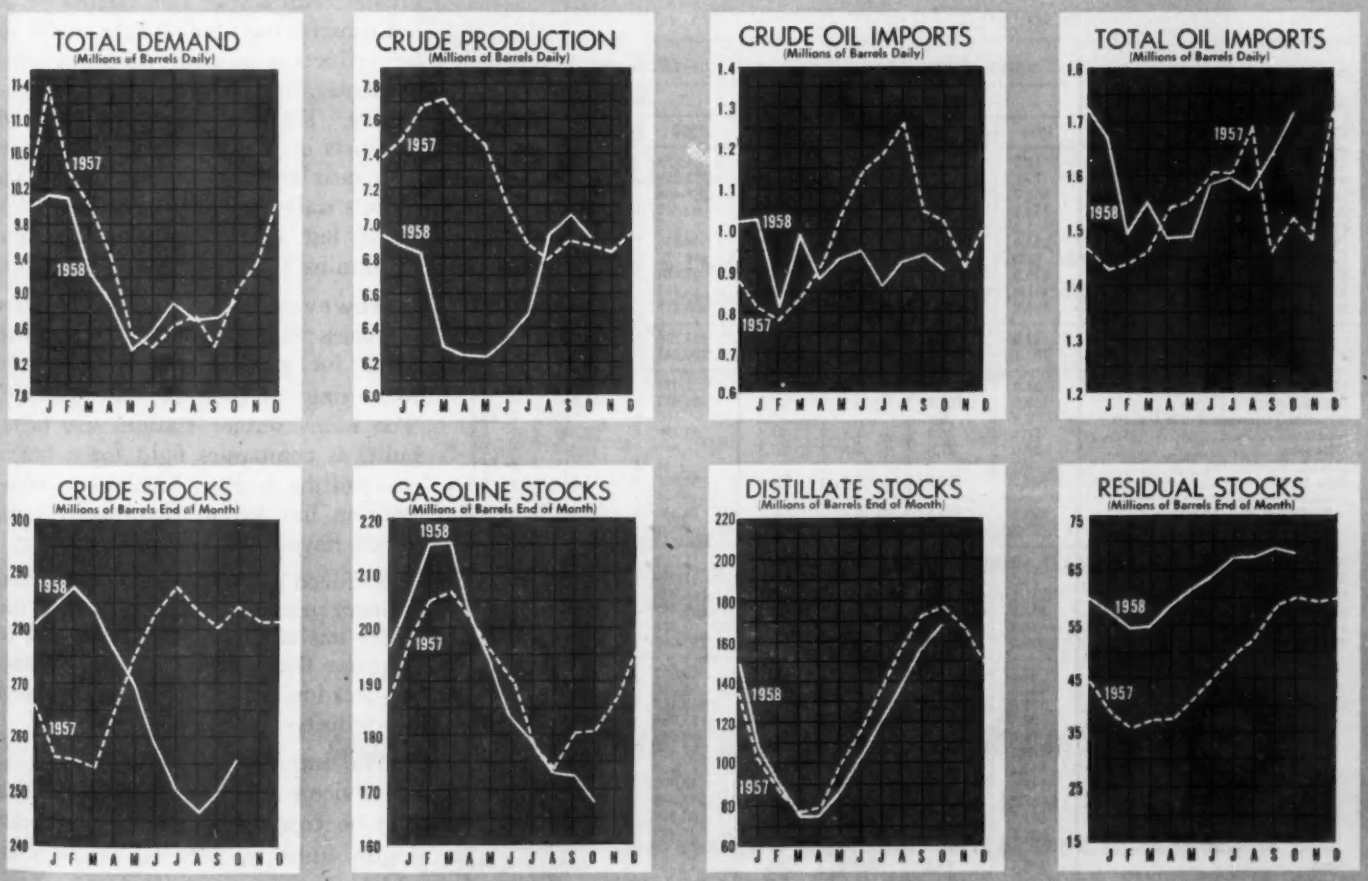
The over-all supply trend has been highly favorable. Nevertheless, prices of both crude oil and refined products remain quite soft, and in some areas have continued previous downward tendencies during the last 30 days.

On the favorable side is the liquidation of surplus refined product stocks and coming higher winter consuming rates.

Most encouraging is the substantial improvement in gasoline inventories. Total U. S. motor fuel stocks in mid-November totaled 169 million barrels, 13 million less than a year ago. In contrast, gasoline inventories a month ago were only 5 million barrels below last year's levels, and just three months ago had been 4 million barrels above 1957 volumes. Gasoline stocks located outside the West Coast are now 9 million barrels less than last year. For the first time in years, the industry has an excellent opportunity to go through the winter without creating surplus gasoline inventories. This can be avoided if refinery output is not permitted to get out of hand.

Distillate stocks also are in excellent condition. In mid-November, they amounted to 164.3 million barrels, 7.6 million below year ago volumes. These

Petroleum Trends...



U. S. Monthly Oil Trends

(THOUSANDS OF BARRELS DAILY)

	OCTOBER			Sept.	JANUARY-OCTOBER		
	1958	1957	% Diff.	1958	1958	1957	% Diff.
U.S. Crude Oil Production	6,910	6,860	+ 0.7	7,056	6,627	7,234	— 8.4
U.S. Nat. Gas Liquids Prod.	800	803	— 0.4	800	784	802	— 2.3
U.S. Total Imports	1,720	1,526	+12.7	1,643	1,650	1,532	+ 7.7
East Coast Crude Imports	709	759	— 6.6	738	754	745	+ 1.2
Total Crude Imports	906	1,022	—11.4	947	934	1,004	— 7.0
Total Refined Products	815	504	+61.7	696	718	528	+36.0
Total New Supply	9,430	9,189	+ 2.6	9,499	9,061	9,569	— 5.3
Stock Changes All Oils (Daily)	+452	+142	.....	+750	—29	+273	.....
Total Demand All U.S. Oils	8,978	9,046	— 0.8	8,749	9,091	9,296	— 2.2
Gasoline Demand	4,017	3,940	+ 2.0	4,140	3,974	3,967	+ 0.2
Distillate Fuel Demand	1,489	1,643	— 9.4	1,259	1,679	1,726	— 2.7
Residual Fuel Demand	1,409	1,455	— 3.2	1,258	1,425	1,571	— 9.3
Domestic Demand, All Oils	8,678	8,687	— 0.1	8,449	8,810	8,689	+ 1.4
Export Demand, All Oils	300	360	—16.7	300	280	607	—53.9
Crude Runs U.S. Refineries	7,696	7,650	+ 0.6	7,703	7,546	7,952	— 5.1
Domestic Crude Runs	6,764	6,697	+ 1.0	6,779	6,618	6,970	— 5.1
Foreign Crude Runs	932	952	— 2.1	927	928	982	— 5.5

	TOTAL U.S. STOCKS Millions of Barrels End of Month				STOCKS EAST OF CALIFORNIA Millions of Barrels End of Month			
	October			Sept.	October			Sept.
	5958	1957	% Diff.	1958	1958	1957	% Diff.	1958
Crude Oil	255.7	284.5	—10.1	249.3	222.3	245.9	— 9.6	209.6
Gasoline	168.6	180.9	— 6.8	172.6	146.2	155.0	— 5.7	150.0
Distillate Fuel Oil	166.3	176.4	— 5.7	156.1	151.8	159.3	— 4.7	142.0
Residual Fuel Oil	68.2	60.0	+13.7	68.9	33.8	35.2	— 4.0	34.3
Kerosine	32.4	34.4	— 5.8	31.3	32.0	34.1	— 6.2	30.9

Source: Except for latest two months, all data from U.S. Bureau of Mines. Data for last two months from American Petroleum Institute weekly reports and U.S. Bureau of Mines weekly crude stock report; except U.S. Natural Gas Liquids Production and Demand figures which are from WORLD OIL.

U. S. Crude Production By States

(THOUSANDS OF BARRELS)

STATE or DISTRICT	DAILY AVERAGE PRODUCTION				TOTAL PRODUCTION		
	October			September	January-October		
	1958	1957	% Diff.	1958	1958	1957	% Diff.
Alabama	16.3	15.2	+ 7.2	15.3	4,859	4,419	+ 10.0
Arkansas	77.1	82.7	— 6.8	73.8	23,790	25,507	— 6.7
California	851.7	926.9	— 8.1	853.9	262,459	283,018	— 7.3
Colorado	132.1	144.1	— 8.3	130.4	40.622	46,167	— 12.0
Florida	1.2	1.3	— 7.7	1.3	377	382	— 1.3
Illinois	224.4	237.0	— 5.3	228.3	68,356	63,962	+ 6.9
Indiana	32.9	35.2	— 6.5	32.7	9,778	10,766	— 9.2
Kansas	335.9	354.1	— 5.1	333.7	97,964	101,278	— 3.3
Kentucky	41.8	47.0	— 11.1	41.2	13,241	14,140	— 6.4
Louisiana	898.2	795.5	+ 12.9	881.2	255,278	273,280	— 6.6
North Louisiana	112.5	118.3	— 4.9	109.8	34,735	39,169	— 11.3
South Louisiana	785.7	677.2	+ 16.0	771.4	220,543	234,111	— 5.8
Michigan	25.6	28.0	— 8.6	24.4	7,674	8,576	— 10.5
Mississippi	109.8	125.3	— 12.4	107.0	31,032	33,390	— 7.1
Missouri-Tennessee-South Dakota	0.4	0.4	.....	0.3	108	86	+ 25.6
Montana	77.1	76.0	+ 1.4	77.6	23,387	22,529	+ 3.8
Nebraska	58.0	57.6	+ 0.7	57.4	16,808	15,979	+ 5.2
Nevada-Washington	0.1	.....	.....	.....	35	19	+ 84.2
New Mexico	283.7	256.7	+ 10.5	279.6	81,917	78,542	+ 4.3
Southeast New Mexico	255.4	249.4	+ 2.4	252.2	75,513	76,627	— 1.2
Northwest New Mexico	28.3	7.3	+287.7	27.4	6,404	1,915	+234.4
New York	5.2	7.3	— 28.8	5.1	1,627	2,254	— 27.8
North Dakota	15.1	28.5	— 47.0	17.1	11,089	11,362	— 2.4
Ohio	16.1	17.1	— 5.9	16.8	5,205	4,115	+ 26.5
Oklahoma	555.2	572.1	— 3.0	560.0	168,387	179,943	— 6.4
Pennsylvania	16.8	22.3	— 24.7	18.1	5,624	6,936	— 18.9
Texas	2,692.4	2,711.1	— 0.7	2,867.3	769,056	918,857	— 16.3
Dist. 1: South Central	47.7	48.6	— 1.9	48.4	14,021	16,395	— 14.5
Dist. 2: Middle Gulf	124.3	124.9	— 0.5	134.8	34,655	45,066	— 23.1
Dist. 3: Upper Gulf	375.0	401.6	— 6.6	401.7	113,197	135,905	— 16.7
Dist. 4: Lower Gulf	202.5	203.8	— 0.6	219.1	57,095	70,123	— 18.6
Dist. 5: East Central	31.5	32.4	— 2.8	34.1	9,087	11,837	— 23.2
Dist. 6: Northeast	276.6	269.9	+ 2.5	299.0	77,425	99,958	— 22.6
Dist. 7-B: North Central	144.3	143.5	+ 0.6	153.8	41,468	48,578	— 14.6
Dist. 7-C: West Central	142.6	142.0	+ 0.4	148.1	40,005	49,041	— 18.4
Dist. 8: West	1,028.8	984.6	+ 4.5	1,107.6	282,888	338,823	— 16.5
Dist. 9: North	211.5	200.7	+ 5.4	212.9	60,287	63,681	— 5.3
Dist. 10: Panhandle	107.5	102.7	+ 4.7	107.8	32,408	31,930	+ 1.5
Utah	106.1	13.5	+685.9	101.9	19,369	3,204	+504.5
Virginia	.....	.....	.....	.....	3	5	.....
West Virginia	6.4	6.5	— 1.5	6.4	1,836	1,846	— 0.6
Wyoming	330.5	298.2	+ 10.8	325.0	94,838	88,446	— 7.2

SOURCE: Bureau of Mines and API. Texas districts from API and do not necessarily agree with State totals.

stocks will be reduced drastically during the approaching winter months.

Crude oil stocks also are in good shape. Rising demand as cold weather arrived has slowed their rate of increase. In early November, crude inventories were only 2.6 million barrels higher than a month ago, although 14 million barrels above two months ago. However, the significant thing in connection with crude oil stocks is that they now total only 255 million barrels, nearly 30 million barrels less than a year ago. This is a very reasonable level for crude oil inventories.

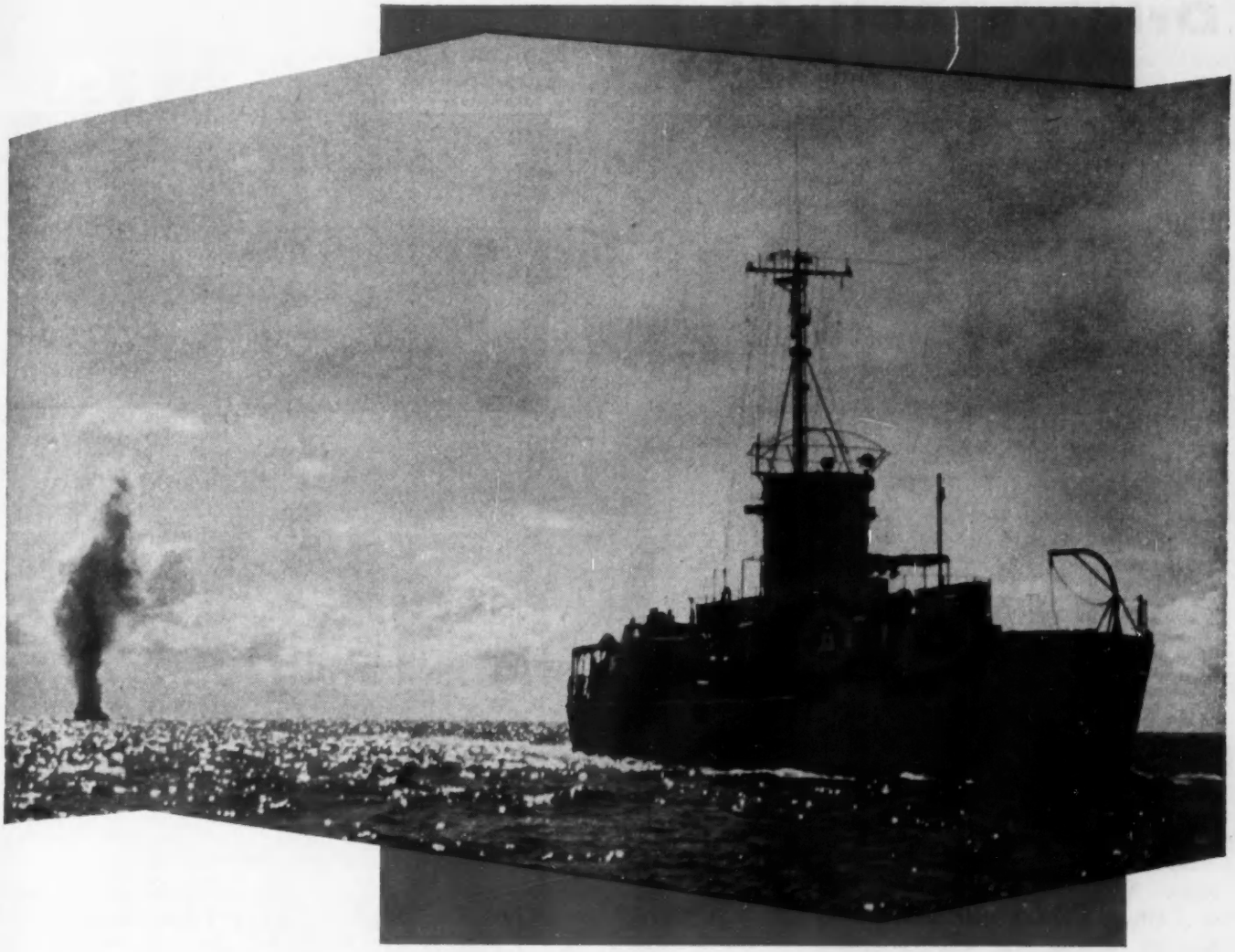
On the unfavorable side are several factors which are exerting a very depressing influence on prices. Shut-in producing ability, both at home and abroad, is one. However, this has been softened by the regulation of both domestic crude oil and refined product production to current needs, except in a few areas. Furthermore, crude oil imports also are being held fairly well in check under the voluntary restriction program.

Unfortunately, refined product imports have been running 300,000 barrels per day, roughly 60 percent, greater than a year ago. Higher product imports have more than made up for reduction in crude imports. Consequently, total imports have been excessive. Total imports (crude and products combined) in October were at a near all-time high of 1.7 million barrels daily, 200,000 barrels per day above last year. Total imports were continuing to rise in early November.

However, chief reason for price weakness is an intense competitive battle for gasoline gallonage in the marketing division of the industry. Too many service stations are being built, as companies fight for a larger share of the market. This intense competition has led to retail price cuts, which have been met by others.

Reduced retailed prices have forced refinery prices downward. In turn, the latter has caused refineries to seek to improve their profit margins by paying less for crude oil. Every phase of the industry has lost.

The industry needs wider spacing of service stations before this situation can be corrected. Since this appears highly unlikely, U.S. oil prices probably will continue to be low and unstable despite present favorable supply and demand relationship.



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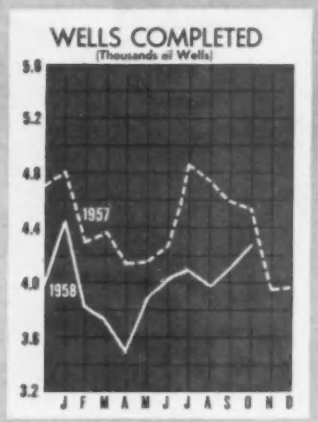
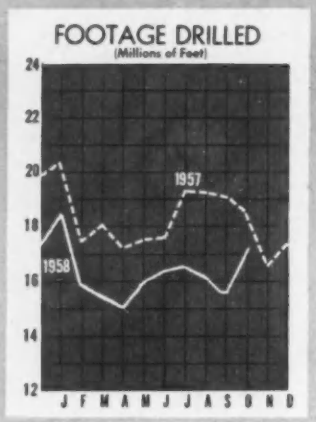
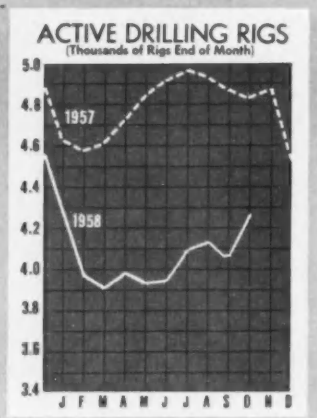
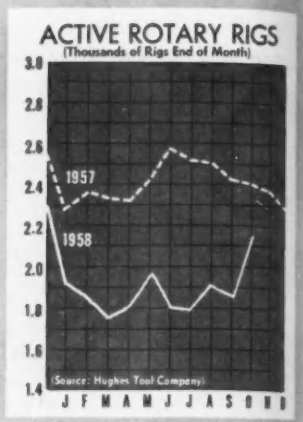
Drilling Activities...









New U. S. well completions reach 39,981

NEW U. S. WELL completions totaled 39,981 for the first 10 months of 1958, indicating that total completions for this year will reach the 48,000 level.

October's new well completions again exceeded the 4,000-well rate, just as in each of the four previous months. With no major decline anticipated in drilling activity during November and December, there is every likelihood that WORLD OIL's forecast of 47,952 completions will be reached and possibly exceeded.

New completions reported in October amounted to 4,334, or 200 wells more than the 4,134 completions recorded in September and 318 more than the 4,016 completions accounted for in August. These are favorable comparisons with the year's low of 3,553 wells, which was reported for April.

Continued drilling activity at the present rate would mean the completion of approximately 8,600 wells during the final two months of this year. Thus, with a total of 39,981 completions for the first 10 months, the chances are good that U. S. completions may range up to the 48,000-plus level.

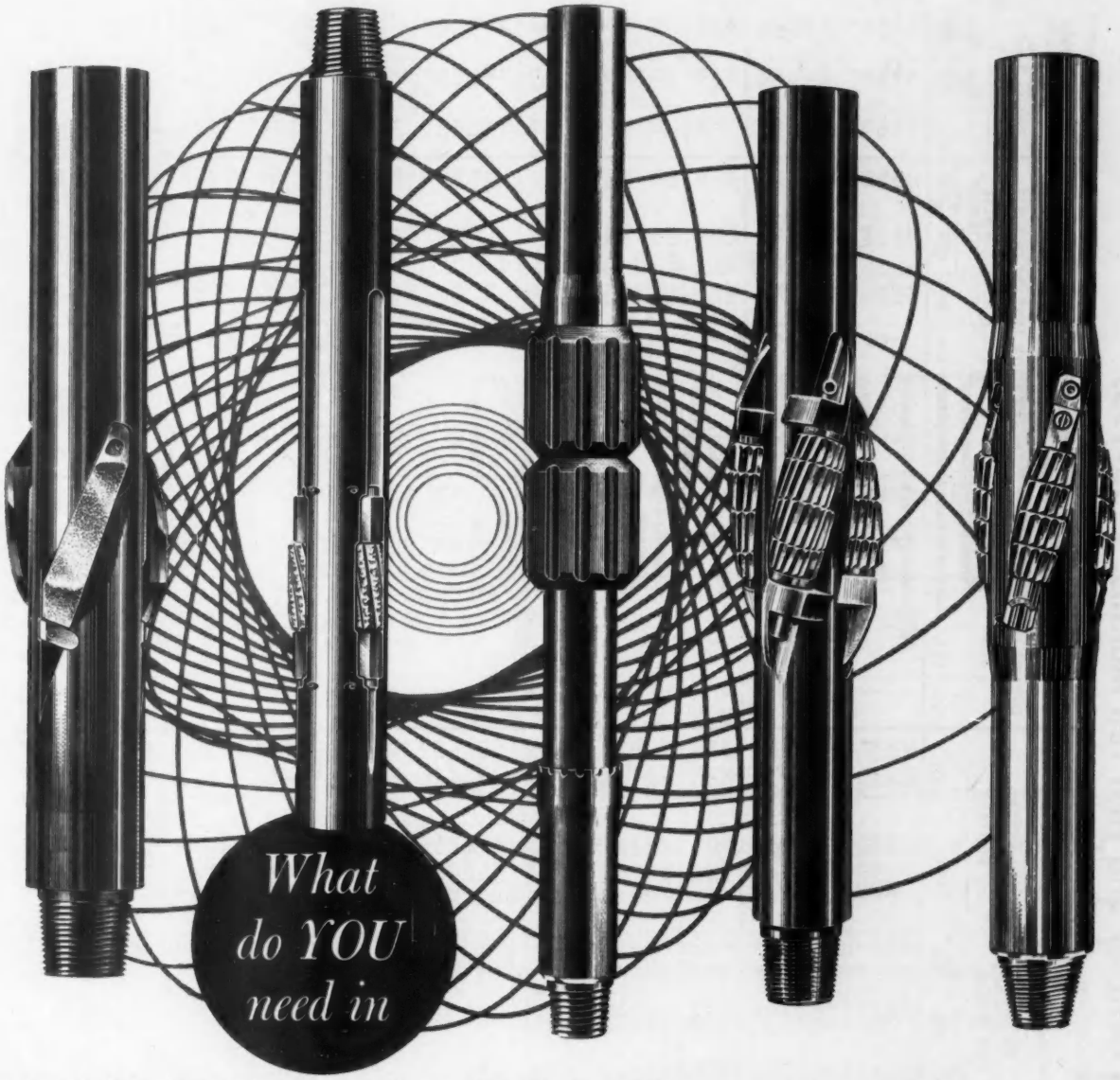
Summary of U. S. Drilling Activity

ITEM	October 1958	Sept. 1958	TEN MONTHS January-October 1958	1957	% Diff.
New Wells Completed:					
Oil	2,041	1,997	19,647	23,352	— 15.9
Distillate	56	50	641	616	+ 4.1
Gas	374	347	3,493	3,126	+ 11.7
Service	176	133	1,185	886	+ 33.7
Dry	1,687	1,607	15,015	16,891	— 11.1
Total Wells	**4,334**	**4,134**	**39,981**	**44,871**	**— 10.9**
Footage Drilled (Mln. of Feet)	**17.3**	**15.6**	**162.5**	**184.8**	**— 12.1**

Summary of U. S. Wildcat Drilling

ITEM	October 1958	Sept. 1958	TEN MONTHS January-October 1958	1957	% Diff.
New Field Discoveries:					
Oil	69	51	607	727	— 16.5
Distillate	7	5	76	108	— 29.6
Gas	22	17	192	195	— 1.5
Total Discoveries	**98**	**73**	**875**	**1,030**	**— 15.1**
Dry Wildcats	813	801	7,259	8,523	— 14.8
Total Wildcats	**911**	**874**	**8,134**	**9,553**	**— 14.7**
Percent Productive	10.8	8.4	10.8	10.8	.....
Percent Dry	89.2	91.6	89.2	89.2	.....

Details on Page 30



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U. S. Drilling Activity in October and First Ten Months, 1958-1957

STATE or DISTRICT	TOTAL NEW WELLS COMPLETED AND FOOTAGE DRILLED: DETAILS FOR OCTOBER, 1958 — Oil	Dist.	Gas	Dry	Service Wells	TOTAL NEW WELLS — Oct. 1958	Sept. 1958	Oct. 1957	Total Footage October, 1958	DETAILS FOR JANUARY-OCTOBER — NEW WELLS — 1958	1957	Percent Diff.	FOOTAGE — 1958	1957
Alabama	5	....	1	2	....	8	10	8	60,056	69	83	— 16.9	566,124	678,158
Arkansas	55	....	3	34	....	92	83	105	317,952	671	938	— 28.5	2,250,609	2,837,550
California	57	....	2	39	....	98	94	203	566,603	1,139	1,849	— 38.4	5,542,546	7,947,030
Colorado	19	....	16	62	....	97	67	68	510,695	719	674	+ 6.7	3,725,456	3,506,336
Florida	....	....	....	....	....	....	1	....	.....	6	8	— 25.0	55,809	57,082
Georgia	....	....	....	....	....	....	1	2	.....	1	5	— 80.0	2,915	25,712
Illinois	89	....	12	97	1	199	248	246	463,075	1,897	2,203	— 13.9	4,365,176	5,074,518
Indiana	37	....	....	76	....	113	94	84	179,654	699	577	+ 21.1	1,139,261	969,503
Kansas	175	....	24	175	7	381	373	365	1,320,060	3,078	3,487	— 11.7	10,596,361	12,358,199
Kentucky	53	....	23	75	....	151	132	188	239,629	1,197	1,481	— 19.2	1,759,278	2,156,020
Louisiana	140	23	23	141	....	327	278	377	2,296,367	2,893	3,191	— 9.3	22,490,592	25,139,550
North Louisiana	59	2	19	82	....	162	144	157	549,302	1,126	1,210	— 7.0	4,185,170	4,386,865
South Louisiana	81	21	4	59	....	165	134	220	1,747,065	1,767	1,981	— 10.8	18,305,422	20,752,685
*Gulf of Mexico	25	5	....	4	....	34	29	60	338,026	418	554	— 24.6	4,024,834	5,242,483
Michigan	17	....	2	28	....	47	24	37	131,696	320	337	— 5.1	920,125	973,646
Mississippi	22	....	1	24	....	47	30	30	421,100	324	321	+ 0.9	2,895,847	2,326,707
Missouri	....	....	....	2	....	2	2	....	4,030	15	9	+ 66.7	15,612	6,110
Montana	15	....	1	14	....	30	20	45	155,750	253	344	— 26.5	1,348,791	1,688,961
Nebraska	28	....	....	53	....	81	67	71	489,702	568	753	— 24.6	3,395,952	4,469,920
Nevada	....	....	....	....	....	....	....	1	.....	....	5	—100.0	.....	11,260
New Mexico	68	....	61	45	....	174	140	207	816,508	1,659	1,880	— 11.8	7,820,232	8,819,257
Southeast	41	....	3	30	....	74	70	107	381,500	832	1,125	— 26.1	4,145,430	5,615,291
Northwest	27	....	58	15	....	100	70	100	435,008	827	755	+ 9.5	3,674,802	3,203,966
New York	24	....	1	2	18	45	45	48	53,400	450	423	+ 6.4	534,000	673,700
North Dakota	31	....	....	11	....	42	27	40	275,563	355	237	+ 49.8	2,320,344	1,624,241
Ohio	41	....	29	20	....	90	68	74	228,392	818	837	— 2.3	2,106,094	2,010,557
Oklahoma	302	6	21	175	79	583	626	373	1,765,889	5,955	4,617	+ 29.0	18,472,594	16,680,864
Pennsylvania	18	....	35	10	8	71	54	90	210,227	580	818	— 29.1	1,693,539	2,101,136
South Dakota	....	....	....	1	....	1	....	5	4,617	6	39	— 84.6	26,804	134,719
Tennessee	....	....	....	5	5	5	5	....	6,550	50	....	.....	62,750	.....
Texas	800	26	59	539	63	1,487	1,482	1,710	6,218,233	14,611	18,309	— 20.2	61,767,464	76,877,278
Dist. 1: South Central	37	2	3	30	....	72	104	89	196,168	817	1,097	— 25.5	1,997,099	2,822,572
Dist. 2: Middle Gulf	12	3	4	35	....	54	56	64	321,907	590	653	— 9.7	3,599,764	3,970,873
Dist. 3: Upper Gulf	48	11	8	55	....	122	84	113	821,444	1,073	1,405	— 23.6	6,885,091	9,281,577
*Gulf of Mexico	....	....	....	2	....	2	....	2	14,477	11	9	+ 22.2	86,748	67,977
Dist. 4: Lower Gulf-S.W.	12	8	....	40	....	60	90	109	341,786	964	1,212	— 20.5	4,997,563	6,393,570
*Gulf of Mexico	....	....	....	....	....	....	....	....	.....	7	19	— 63.2	75,300	181,268
Dist. 5: East Central	8	....	....	7	....	15	25	14	48,504	166	143	+ 16.1	610,050	643,324
Dist. 6: Northeast	35	2	4	26	....	67	70	82	382,155	695	911	— 23.7	3,679,147	4,912,848
Dist. 7-B: North Central	91	....	1	100	1	193	188	244	583,688	1,819	2,298	— 20.9	5,813,339	7,675,669
Dist. 7-C: West Central	36	....	5	28	....	69	54	95	307,599	657	998	— 34.2	3,234,044	4,557,011
Dist. 8: West	267	....	2	50	40	359	366	419	1,753,994	3,542	4,213	— 15.9	16,996,077	20,627,833
Dist. 9: North	181	....	12	139	21	353	314	354	920,587	3,173	4,141	— 23.4	9,034,051	11,014,031
Dist. 10: Panhandle	73	....	20	29	1	123	131	127	540,401	1,115	1,238	— 9.9	4,921,239	4,977,970
Utah	17	1	3	10	....	31	21	35	169,291	346	213	+ 62.4	1,925,307	1,167,821
Washington	....	....	....	1	....	1	1	....	7,419	6	4	+ 50.0	33,282	20,459
West Virginia	15	....	48	9	....	72	63	68	197,639	692	551	+ 25.6	1,862,663	1,512,455
Wyoming	12	....	4	34	....	50	71	93	192,363	572	672	— 14.9	2,699,142	2,954,016
Others	1	....	4	3	....	8	7	1	38,030	32	6	+433.3	144,343	27,848
Total United States	2,041	56	373	1,687	176	4,333	4,134	4,574	17,340,490	39,981	44,871	— 10.9	162,539,012	184,830,613
Total Western Canada	125	....	10	50	10	195	224	218	975,000	2,099	2,525	— 16.9	10,467,586	11,771,220

STATE or DISTRICT	WILDCAT DRILLING IN OCTOBER AND FIRST TEN MONTHS, 1958-1957: DETAILS FOR OCTOBER, 1958 — Oil	Dist.	Gas	Dry	Total Wildcats	DETAILS FOR JANUARY-OCTOBER — Oil	Dist.	Gas	Dry	TOTAL WILDCAT — 1958	1957	DRILLING RIGS IN OPERATION (Rigging up, Drilling, Temp. Shut-Down) — Oct. 31, 1958	Sept. 30, 1958	Oct. 31, 1957
Alabama	1	....	....	1	2	1	....	....	24	25	35	15	16	12
Arkansas	....	....	....	14	14	6	2	7	115	130	145	56	46	64
California	1	....	....	21	22	7	....	2	208	217	309	125	128	166
Colorado	3	....	5	48	56	23	....	16	361	400	401	61	65	72
Florida	....	....	....	....	....	....	....	....	6	6	8	2	2	1
Georgia	....	....	....	....	....	....	....	....	1	1	5	....	1	....
Illinois	....	....	....	42	43	6	....	....	487	493	626	326	305	255
Indiana	2	....	....	31	33	5	....	1	184	190	140	113	105	114
Kansas	10	....	2	82	94	101	....	22	678	801	829	354	329	603
Kentucky	3	....	....	7	10	10	....	2	56	68	105	107	119	135
Louisiana	2	3	....	57	62	29	19	6	437	491	525	342	326	405
North Louisiana	1	....	....	25	26	13	....	....	151	164	154	72	56	83
South Louisiana	1	3	....	32	36	16	19	6	286	327	371	270	270	322
*Gulf of Mexico	....	....	....	3	3	3	1	2	31	37	62	36	45	69
Michigan	1	....	1	18	20	6	....	4	102	112	120	77	76	71
Mississippi	....	....	....	15	15	10	1	....	119	130	159	63	57	50
Missouri	....	....	....	2	2	....	....	....	8	8	9	3	4	....
Montana	1	....	1	9	11	6	1	5	87	99	125	43	35	53
Nebraska	6	....	....	30	36	26	....	....	233	259	385	37	35	17
Nevada	....	....	....	....	....	....	....	....	.....	.....	5	....	1	1
New Mexico	4	....	2	24	30	32	2	17	190	241	256	152	175	181
Southeast	2	....	....	18	20	22	2	4	125	153	165	57	62	101
Northwest	2	....	2	6	10	10	....	13	65	88	91	95	113	80
New York	....	....	....	....	....	....	....	....	.....	.....	.....	42	42	61
North Dakota	2	....	....	10	12	21	....	....	89	110	109	36	40	43
Ohio	....	....	....	....	....	....	....	....	7	7	8	228	224	196
Oklahoma	7	....	3	50	60	56	11	29	532	628	569	531	473	613
Pennsylvania	....	....	1	1	2	....	....	2	21	23	37	175	162	185
South Dakota	....	....	....	1	1	....	....	....	6	6	37	4	3	2
Tennessee	....	....	....	2	2	....	....	....	20	20	.....	....	....	....
Texas	23	4	7	316	350	252	40	75	3,024	3,391	4,269	1,014	978	1,188
Dist. 1: South Central	....	....	1	24	25	10	1	2	271	284	315	35	39	54
Dist. 2: Middle Gulf	1	....	1	24	26	11	8	10	180	209	227	30	34	30
Dist. 3: Upper Gulf	1	3	3	31	38	9	6	10	272	297	375	93	82	107
*Gulf of Mexico	....	....	....	2	2	1	....	1	7	9	4	....	1	1
Dist. 4: Lower Gulf-S.W.	1	....	....	29	30	19	11	6	354	390	379	59	53	72
*Gulf of Mexico	....	....	....	....	....	....	....	....	2	2	2	1	....	3
Dist. 5: East Central	....	....	....	6	6	2	1	1	92	96	100	11	16	11
Dist. 6: Northeast	1	1	....	16	18	6	4	3	163	176	211	62	62	61
Dist. 7-B: North Central	5	....	....	61	66	62	3	8	568	641	857	87	76	110
Dist. 7-C: West Central	2	....	2	17	21	26	....	8	159	193	287	67	66	77
Dist. 8: West	8	....	....	39	47	63	1	6	371	441	452	308	275	354
Dist. 9: North	4	....	....	52	56	34	2	6	506	548	940	169	181	193
Dist. 10: Panhandle	....	....	....	17	17	10	3	15	91	119	126	93	94	119
Utah	....	....	....	7	7	....	....	....	71	71	92	41	33	69
Washington	....	....	....	1	1	....	....	....	5	5	3	1	1	1
West Virginia	....	....	....	....	....	....	....	....	6	6	22	216	189	177
Wyoming	2	....	....	23	25	10	....	3	165	178	214	118	80	105
Others	....	....	....	1	1	....	....	1	17	18	6	4	6	5
Total United States	69	7	22	813	911	607	76	192	7,259	8,134	9,553	4,286	4,056	4,844
Total Western Canada	....	....	....	....	....	....	....	....	.....	.....	.....	177	207	168

* Gulf of Mexico wells are included in their respective district total.

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Practical Operating Hints

These How-To-Do-It Ideas Can Save You Money

$10 is paid for each illustrated acceptable contribution. Mail to The Editor, WORLD OIL, P. O. Box 2608, Houston 1, Texas

Pot on Test Separator Gages Shrinkage

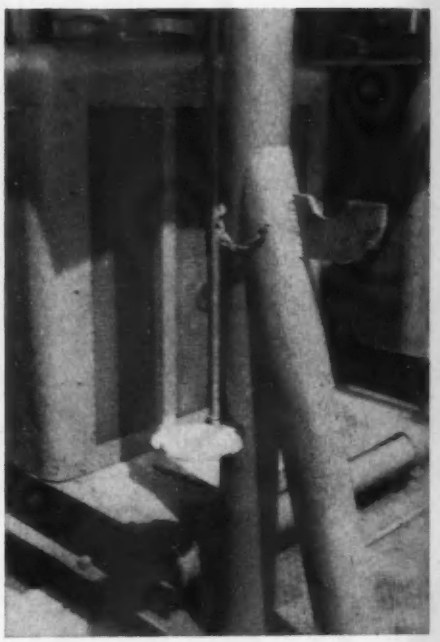
When a well is being tested through a high pressure separator equipped with meters to measure the production, there is always the question in the mind of the operator concerning the exact amount of stock tank oil or distillate that is being produced. The discharge from the unit is emptied into a burning pit requiring meter measurement under pressure.

A calibrated vessel (operating at atmospheric pressure) on the downstream side of this separator shows the operator just how much stock tank oil is being produced in each dump of the separator. It is calibrated from 0 to 100 percent so that with each dump of the separator, the amount of shrinkage can be read directly and this percentage deducted from the gross meter reading. After each dump it is a simple manner for the field engineer to read the glass gage showing the amount of liquid existing at atmospheric pressure.

Build Convenient Rack For Fire Extinguisher

A handy fire extinguisher can put a stop to most fire troubles before they have a chance to get a good start. This is especially true around a drilling rig where an uncontrolled fire can be costly in lives, money and resources.

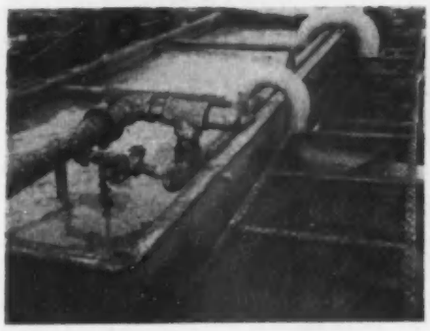
Here is an idea for putting your hand fire extinguishers where they are most likely to be needed and making them readily accessible.



Cut a steel plate the size and shape of the base of the extinguisher. Weld three 1-inch squares of steel plate at 90 degree intervals around the edge of the base plate, as shown in the photograph. The fourth, or open side of the plate, is welded or bolted to the rig. This makes a small holder in which the extinguisher may be set.

To hold the top of the fire extinguisher in place, use a small piece of light weight chain. Weld one end of the chain to the structure on which the holder is mounted. Wrap the chain around the extinguisher and latch it to a hook, bolt or separate link of chain welded to the rig. Be sure the latching device for the chain is easy to release.

Merry Christmas
and may your New Year be every bit the best!
H C Smith
OIL TOOL CO.



Hinged Gratings Make Excellent Cat Walks

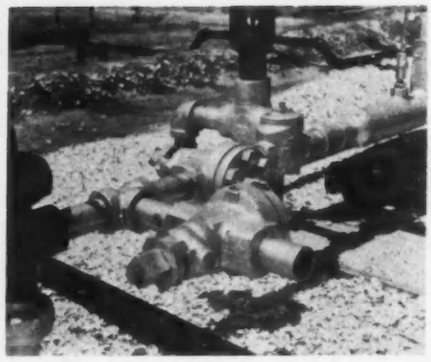
Cat walks along mud tanks may be rigged up for easy moving by taking a link from a rotary chain and welding it up between the walk and the tank as shown. Angle iron braces are then hinged to the sides and when the tank is spotted on the new location, it is only necessary to swing the walks up in place and insert the braces. Grating material is used to cover the frames so that there is no danger of slipping.

Pop Valve Protects Line Heater

The installation illustrated can provide cheap insurance if a regulator failure occurs between the low pressure heater supply gas system and the main high pressure system.

The pop valve is installed just upstream of the low pressure supply system and the discharge piped a safe distance away from the unit. The hook-up is extremely useful when installed on packaged production units where a high pressure separator and line heater are skid-mounted together. If the supply regulator should fail and place full gas sales line pressure on the lower pressure connections and equipment, the relief valve will safely divert the gas flow to a pit away from the unit. Without the valve there is a possibility of losing the producing equipment due to explosion and fire.

The relief valve can be set to any desirable relief pressure lower than the pressure rating of the weakest connection and higher than the recommended heater supply gas pressure.



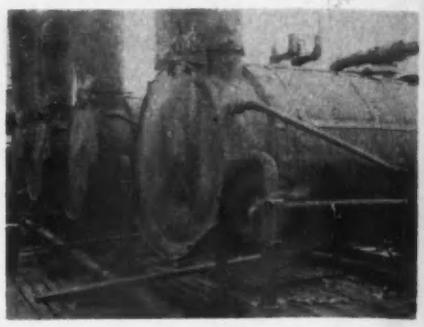
Pipe Joint Threads Preserve Open Valves

Threads cut from joints of pipe during tank battery construction make excellent protectors for open ended valves.

There are many occasions during piping operations when threaded joints of pipe must be cut into shorter lengths for proper fitting. The excess pipe threads cut from these joints can be effectively used as shown.

The photograph shows a gas line "blow down" valve which is open ended at all times. (The valve is connected on one end with the other open to the atmosphere). If the "junk" piece of threaded pipe were not used as a protector for the valves exposed female threads, these threads could be damaged beyond repair by corrosion, rust, etc. With damaged threads on one end, the valve would be useless for other than this type of service.

Installation of the "doped" protector will effectively preserve exposed valve threads.



Preheater Connection Raises Boiler Efficiency

With the increased cost of gas for boiler fuel, the users of steam rigs must watch every corner to keep up the boiler efficiency. Besides covering the boilers with insulation, this contractor runs his feed water through coils of 2-inch tubing which are placed in the back of the boilers. After the heat has been absorbed from the fuel in the boiler tubes, the "squeal" is picked up on the back end of the boilers before it goes out the stack.

Another simple connection is to place the exhaust from the mud pumps so that it is jected up the stacks in the boilers to increase the draft and the efficiency of the boilers. This is done by running the exhaust pipes beneath the stacks and turning them up into the stacks. This also cuts down the noise around the rig and places it at a distance from the rig floor.

How-To-Do-It Ideas Earn Money, too!

WORLD OIL editors want how-to-do-it ideas, so your favorite short cut or invention could put money in your pocket! Write down the substance of your latest ideas and send them in with a picture or drawing of the installation . . . if accepted, $10 for each idea will be yours. Send those money-making ideas today to Hints Editor, WORLD OIL, P. O. Box 2608, Houston 1, Texas.

Here's the newest development in wire rope—

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This new wire rope was developed to meet the need for longer life in sand lines, swabbing lines, coring lines and cable tool drilling lines. It has a plastic impregnated fiber core which combines the good deterioration resisting properties of a plastic core with the excellent strand supporting characteristics of a fiber core.

The plastic protects the fiber and prevents absorption of acids and other hole fluids. Consequently, the rope retains its structural balance even when used in drilling or swabbing acidized or sour wells.

One of these new Fibreseal ropes was used in cleaning out 23 wells. Twelve of the wells were acidized and very corrosive. After four months of service, the rope was checked for deterioration. The core was found to be in good condition, having resisted all well fluids without trouble. The user was extremely well pleased with the extra service life he obtained, and the behavior of the line has been very satisfactory.

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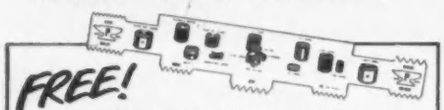

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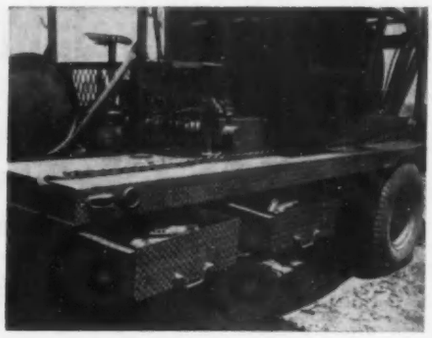
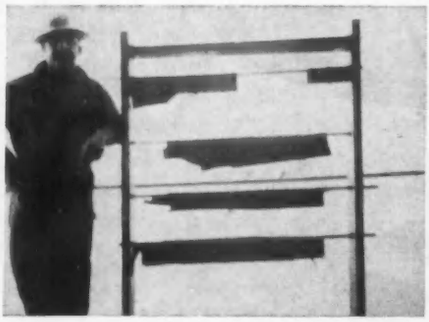


Install Tool Drawers Beneath Truck Bed

Drawers made of floor plate material can be easily installed beneath the truck bed when the pulling unit is being mounted. They are made deep enough to hold all the hand tools and long enough to reach near the center of the truck bed.

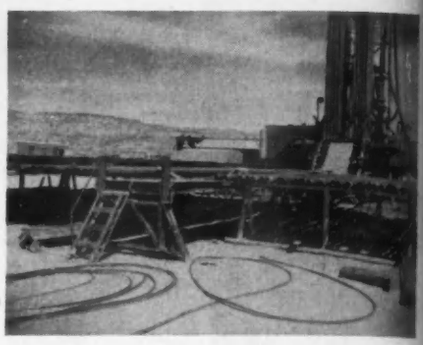
They are attached by taking two matched pieces of angle iron and welding one to the bottom of the bed and the other to the top edge of the drawer. They are made with approximately ½-inch drop toward the center so that they will stay "put" when the truck is on the road. This contractor believes drawers are inconspicuous with no locks.



Homemade Rack Keeps Gasket Material Dry

This is a homemade rack to keep gasket material dry and neat. Make a frame out of 2-inch by 6-inch wood as shown in the picture. Drill holes on each side for ½-inch pipe or broom handles to pass through. Gasket material rolled up and tied with a piece of string can easily be kept neat.

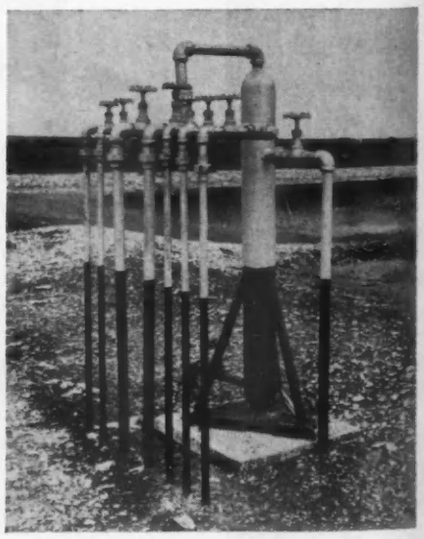
When a piece of gasket material is needed, the amount can be rolled off and cut, the remainder tied back up.



Telescoping Cat Walk Speeds Rigging-Up

On mobile rigs where the truck is backed under the fifth wheel to move the rig, the catwalk between the drill pipe racks may be made to telescope back into the truck bed. When the truck is backed in and the rig is spotted, the truck is disconnected and the walk pulled out into place with a winch line.

The support is then placed under the end of the telescoping part as shown, and the rig is ready for business. The support is adjustable to level the catwalk where the ground is not even.



Tank Manifold Controls Low-Pressure Lines

This supply gas scrubber and manifold can be easily constructed and

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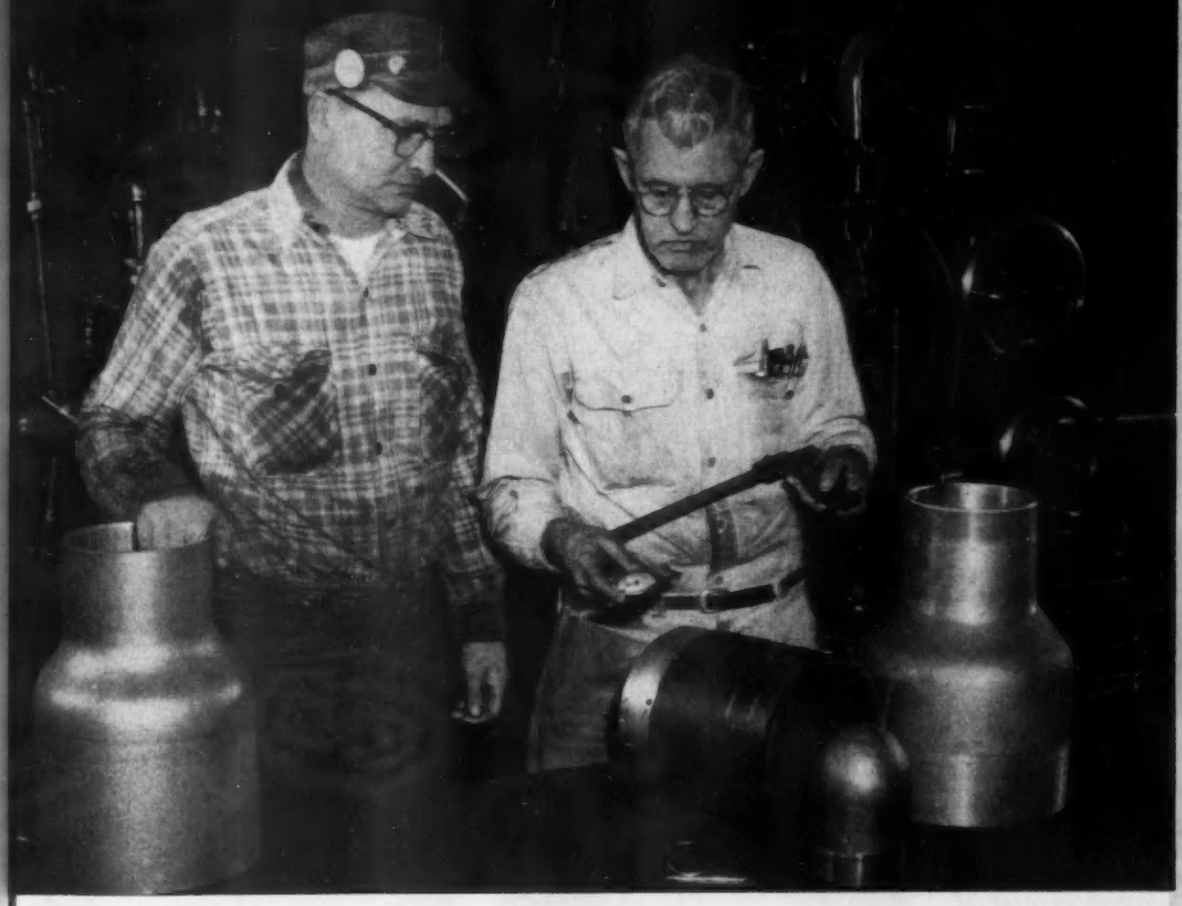

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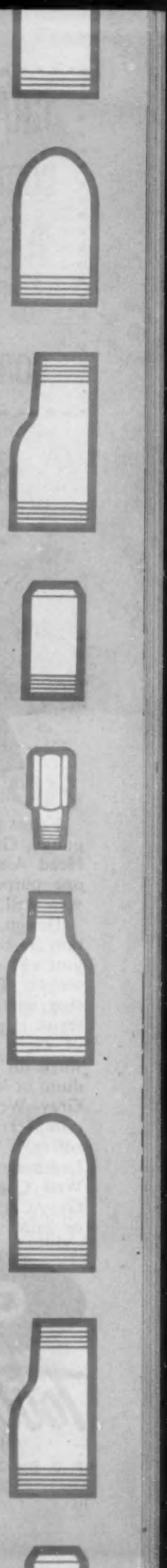

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installed on any tank battery installation. The manifold provides a central point from which all low pressure gas lines originate within the battery. This arrangement permits field personnel to isolate immediately any supply line in case of leakage, welding or cutting operations around any fired vessel etc.

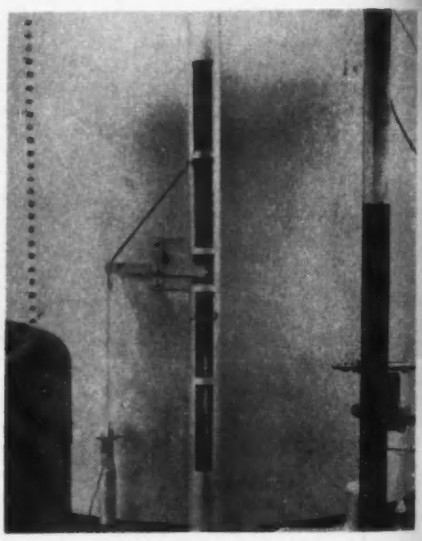
The scrubber is constructed of a piece of orange peeled 4-inch pipe and is equipped with a 1-inch inlet, outlet and drain. Clean gas passes out the top of the scrubber into the 1-inch horizontal header (located immediately behind the row of valves shown). This header is constructed of 1-inch tees and short 1-inch nipples. Any number of tees can be used in the header providing any desired number of individual supply outlets. The ½-inch supply lines shown provide low pressure supply gas to various pneumatic operated pilots and motor valves within the battery. The larger 1-inch lines provide fuel gas for heater treaters. All supply lines are connected to the manifold by means of unions. In this manner the manifold can be constructed in the doghouse or shop if desired.

Holes in Sheet Metal Keep Belts in Sight

Keeping a constant check on the belts around your rig that drive the pumps, motors and other units is a "must" in a good preventive maintenance program. Being able to make visual checks frequently without a minimum loss of time has additional advantages. Here is one of the simplest and safest ways of providing constant visual access to these belts and improving your chances for efficient operation.

The illustration shows large holes cut in the face of the sheet metal guard covering the belts. These holes are then barred with small diameter steel rods welded in place. The close spacing of the bars keeps hands and tools from getting inside the guard but does not hinder visual inspection of the belts.

To make them conspicuous, the bars are painted a bright color. In addition, rig hands glancing at them can see any obvious irregularity in the belts between regular inspections.



Liquid Level Control Operates Pump Throttle

The field constructed liquid level control shown in the photograph is used to control the engine speed of the field salt water disposal pump. The simple, easily fabricated control illustrated has operated successfully for a number of years.

A 2-inch piece of pipe is attached to the side of the salt water disposal tank. The weight shown inside the slotted portion of the pipe is attached to a small cable which runs over a small sheave mounted on top of the pipe section (sheave not shown). The cable then is attached to a float which rides on the surface of the salt

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In the photo above you see Cat D8 Tractors digging out access roads and leveling a drill site on a new oilfield location south of Bakersfield. These machines are on the job day in, day out, 12 months of the year. Besides preparing site, they're ready for excavating slush pits, for skidding rigs, for tank and firewall construction. They team up with 'dozers, winches and rippers to move a lot of earth in a hurry.

The D8, for example, packs 191 flywheel HP. It is available in either a torque converter model or direct drive with the exclusive Caterpillar oil clutch that rarely needs adjusting. This feature helps keep machines where they belong—out on the job—and cuts down on maintenance and service costs.

Take a real close look at these big yellow machines. Then have your Caterpillar Dealer demonstrate any Caterpillar track-type Tractor on your job. See for yourself how versatile it is, how it piles up production. Check the features that guarantee the kind of durability Otto McEuen looks for . . . the kind of durability *you* want, too.

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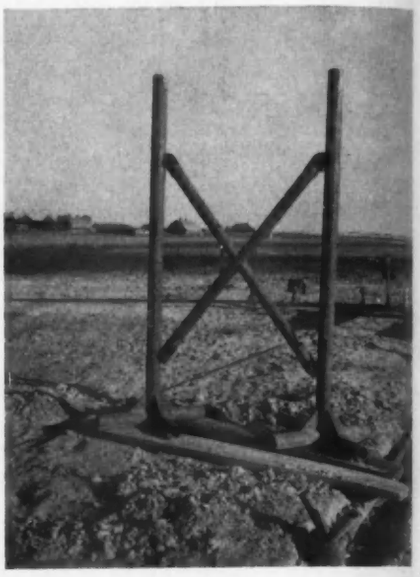
BEST BUY IN OILFIELD EQUIPMENT

water in the tank. Obviously, any change in level or salt water will affect the weight and cause it to move up or down. A small cable clamp is attached to the float cable.

If the float were to move downward, the clamp (and weight) would move upward until the clamp engages the horizontal pivot arm shown. The small steel plate in the center of the photo is welded to the pipe. The pivot arm acts about the middle bolt as a center. The spring shown (attached to the arm and to the pipe) tends to keep the arm in an upward position (this is the "off" position for the throttle since it is connected to the pivot right arm by the small wire shown). When the cable clamp moves the right hand portion of the pivot arm upwards, this releases tension on the throttle, and the disposal pump engine runs at a faster rate of speed. By adjusting the position of the cable clamp, any desired level of water may be maintained in the collection tank.



Drilling Mast Stand Easy to Disassemble

A drilling mast stand which combines necessary ruggedness but which easily and quickly is dismantled into three pieces for hauling between locations, is used by a Canadian drilling contractor.

Instead of making the stand an all-welded, single unit, the welder fabricated the drill pipe material X-bracing as a single unit which can be pinned at four points to ears welded to the uprights. The pins, attached at their respective places by short lengths of chain, make fast work of assembling and disassembling operations. Hand-holds of sucker rod material further aid the moving and positioning of the stand.

Collapsible Stand Helps Working Conditions

Pulling valves and doing other work around the pumps and engines on a rig can be difficult even under good conditions. This collapsible stand is one way to improve working conditions. It provides the solid footing

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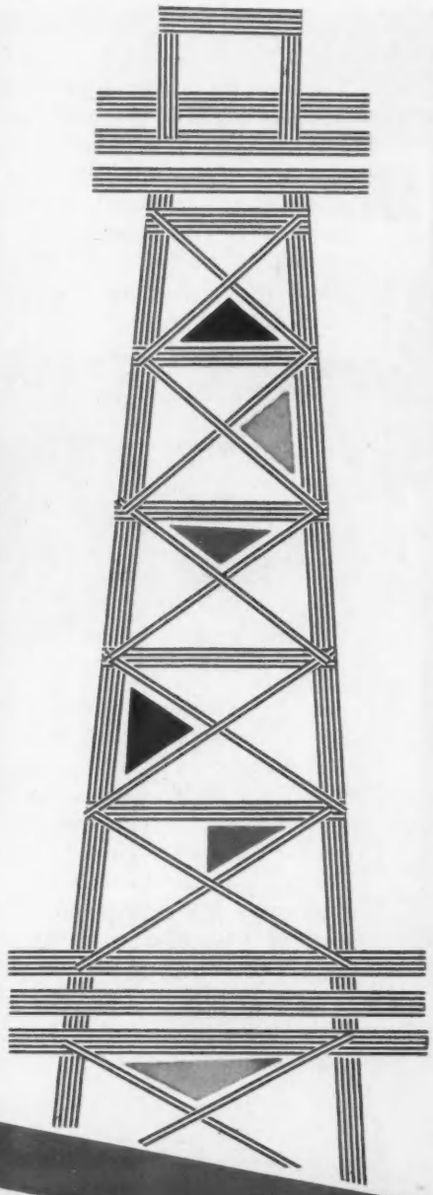

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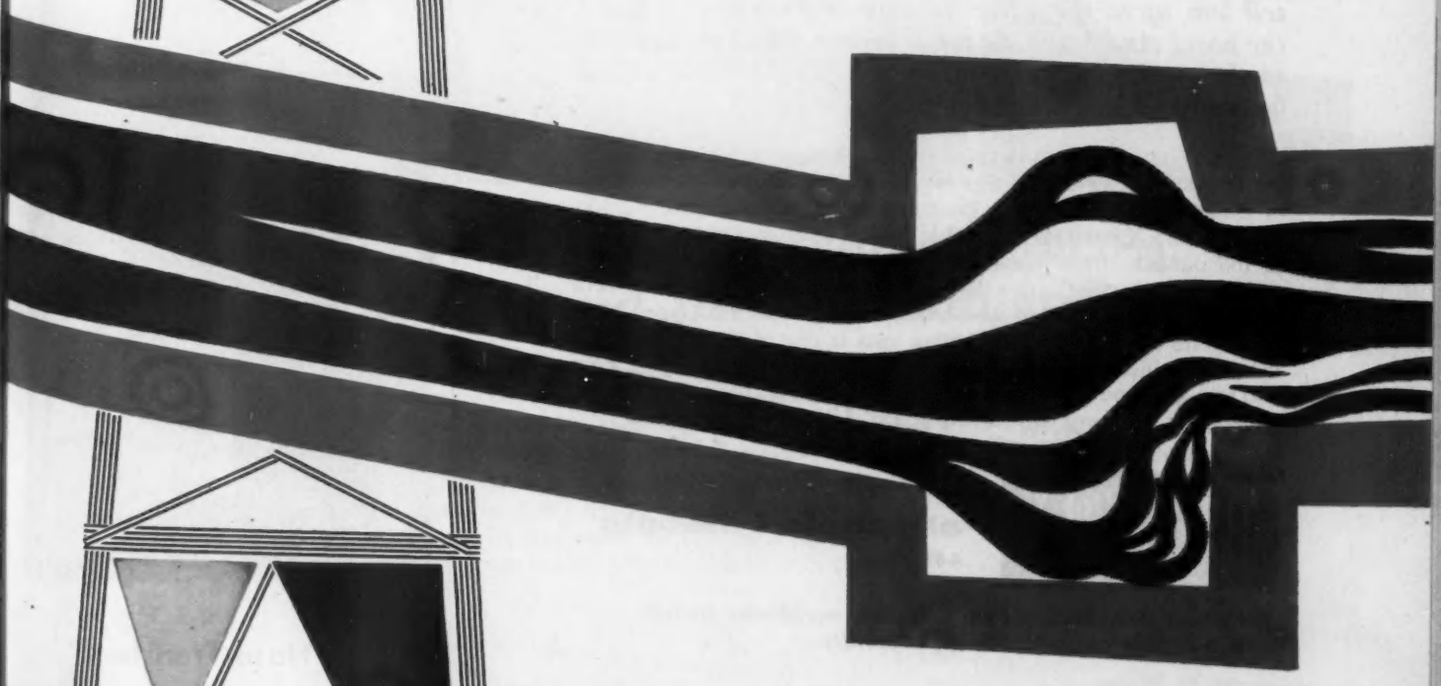

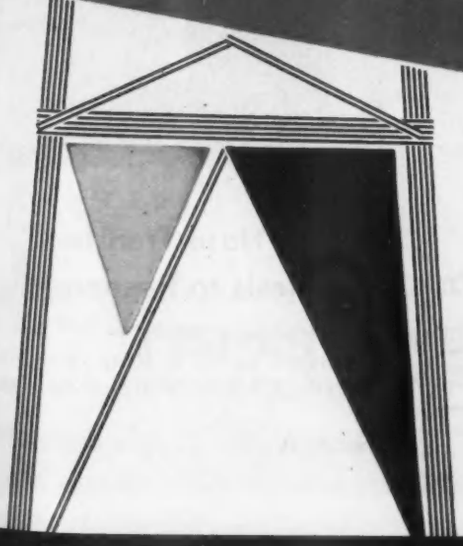

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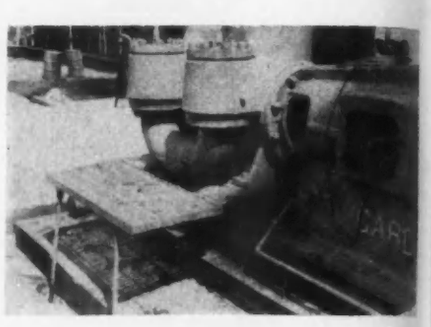
necessary for pulling on wrenches and lifting heavy parts.

The stand is made of steel grating hinged to brackets which are welded to the frame of the pump or motor. It can be made to any desired length. The width of the stand, however, is controlled by the amount of space available for folding it down, out of the way, when it is not in use.



The legs which support the outside edge of the stand are pivoted. They may be extended straight down to the ground, set on blocks or angled in to the frame of the unit, whichever is most convenient. Bright paint or luminous tape applied to the edges of the stand make it conspicuous when it is in working position.

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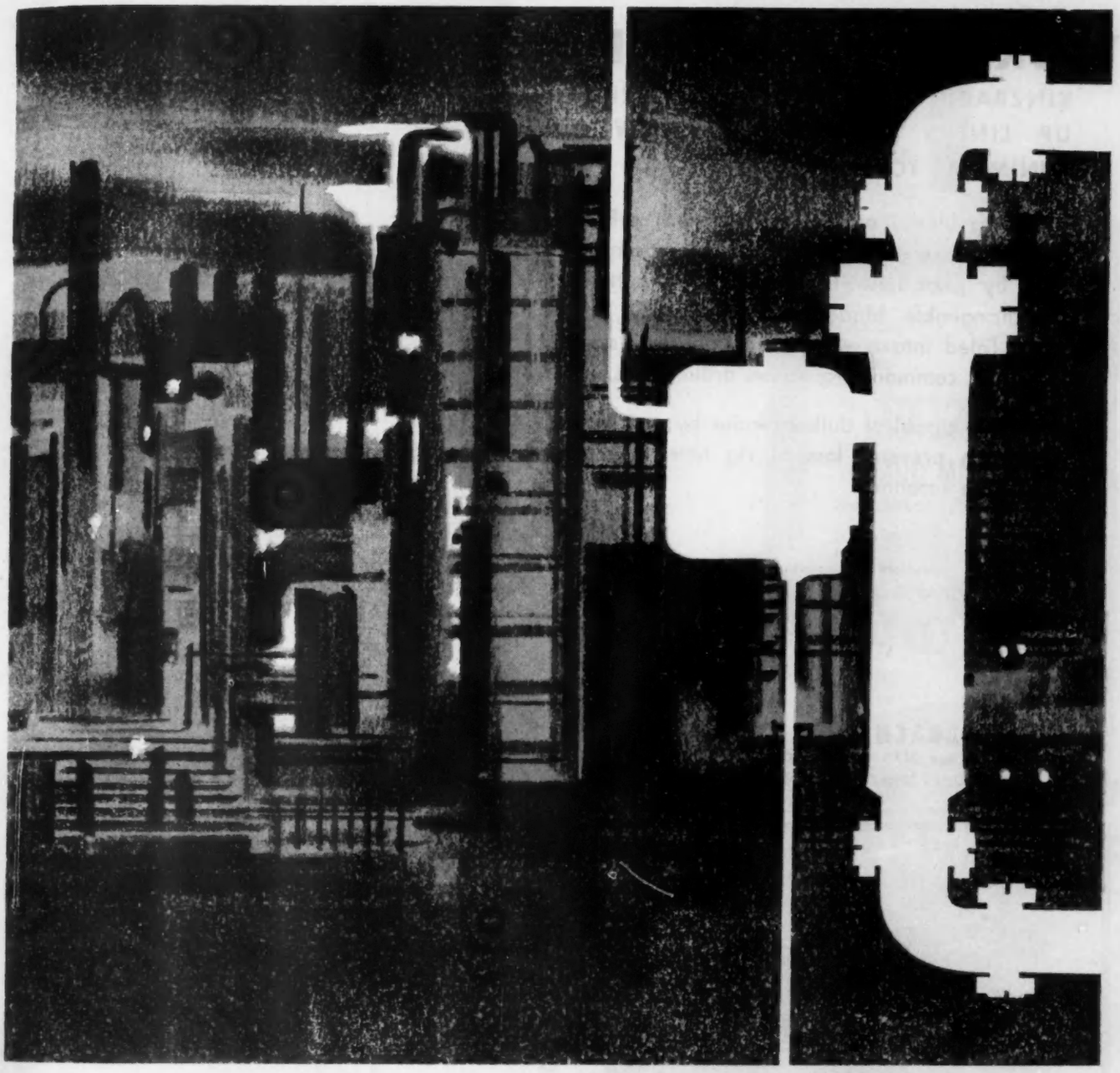

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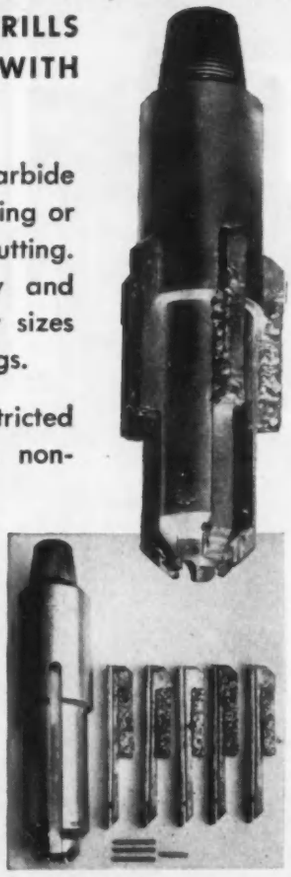

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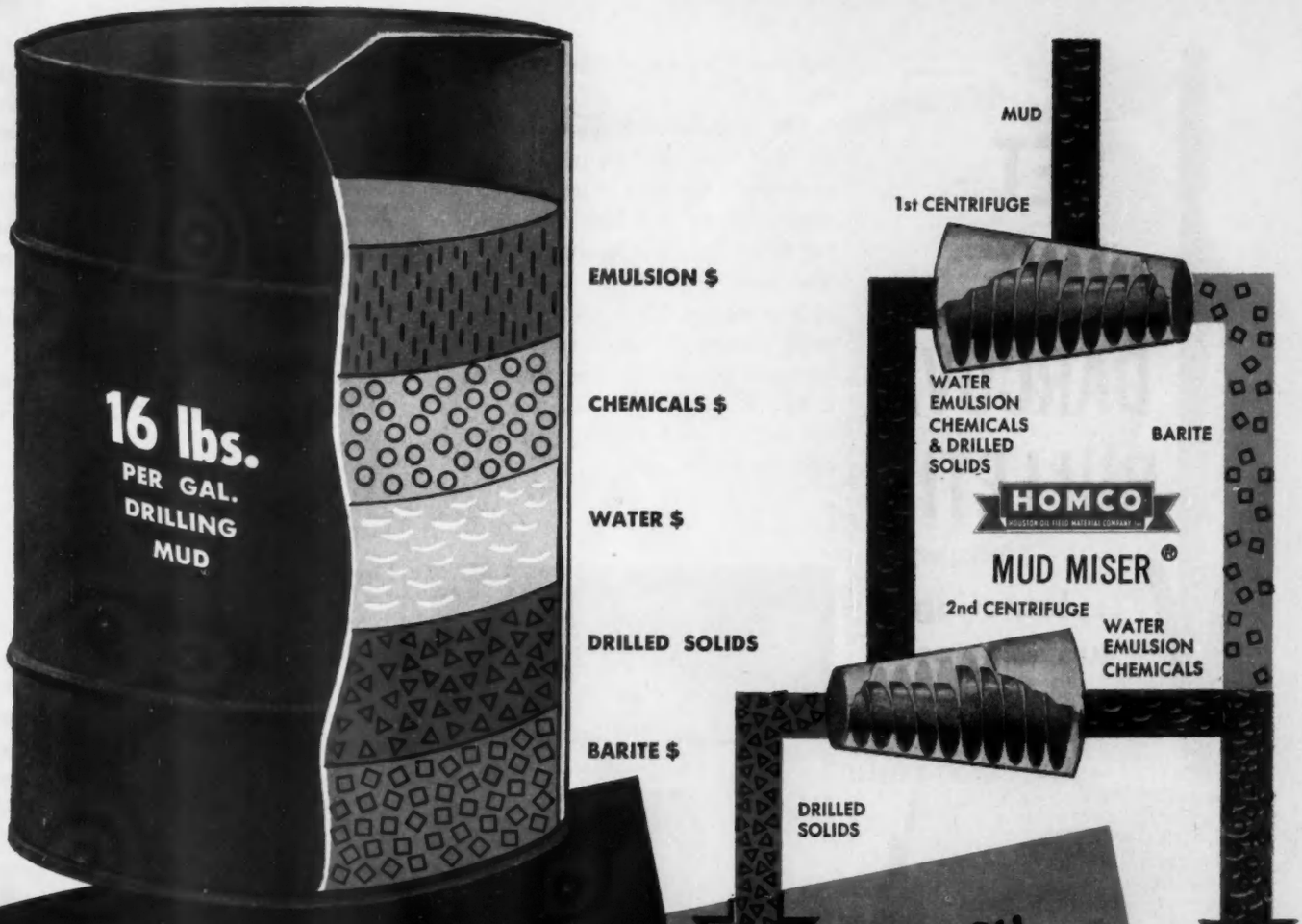
In most cases a hand container is used by field personnel to transfer chemical from the drum to the pump. Many times a considerable quantity of chemical is lost due to spilling or overflowing the hand container while filling. Use of the method shown can save money in lost chemicals. Field personnel simply open the faucet when the reservoir requires filling.

Cement Foundation for Rig and Pump Unit

When drilling in proven fields, a standard procedure was arranged by one company so that the crew who made the rig foundation also made the foundation for the pumping unit. It consists simply of a concrete slab with a square hole in the middle for the rig's cellar. It is then a simple matter to spot the substructure for the drilling rig, and when it is moved off, the pumping units being skid-mounted are brought in and bolted down on bolts which are grounded in the origi-



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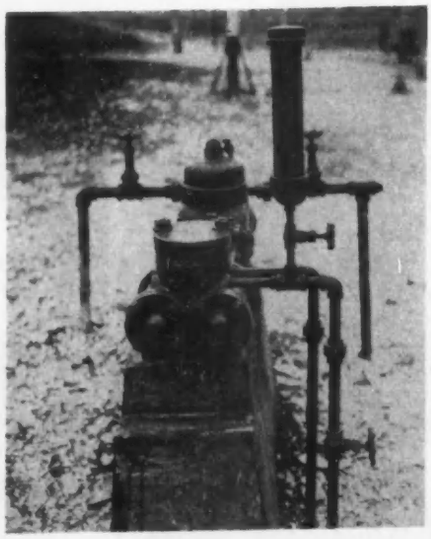
nal concrete out of the way of the rig.

The foundation is made by leveling off the site and laying reinforcing material in the area to be covered and then running a 6-inch slab, usually furnished by transit mixed trucks. The hole is made by setting forms approximately 4-feet-square. Then the cellar is dug to allow space for the blowout preventers and the casing head. As soon as the concrete is set, the foundation for the rig is moved in and the rig set up.



Install a Lubricator On Gas-Operated Pump

The lubricator shown in the photograph is installed on the input gas line to the power end of a tank battery fire wall pump. Many small size steam pumps have found valuable use as fire wall circulating pumps. These pumps generally are powered by lease gas instead of steam. Due to the nature of most wet field gas (many contain salt water etc.) some means of lubricating the pump slide valves is required. In order to provide a convenient means of lubrication, the pot or lubricator illustrated is used.

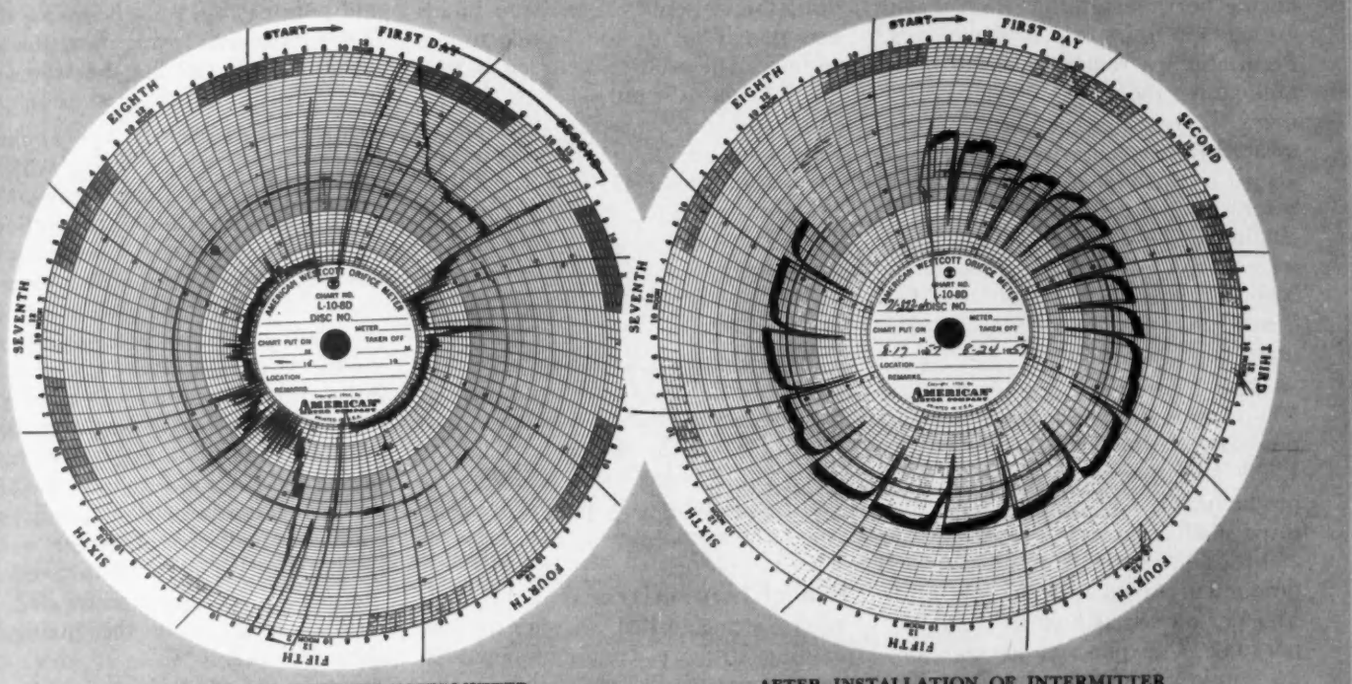
A tee is installed running in the input gas line to the pump. Two nipples, a bushing and a valve complete the connection requirements for the installation shown. The lubricator is installed on top of the last nipple. By removing the screwed cap on top, oil can be poured into the pot. Each time the pump is used, the valve below the lubricator is opened and any desired amount of oil is allowed to flow into the gas stream and into the pump. This provides sufficient lubrication for the steam end valve parts. If necessary, the valve below the lubricator can be "cracked" and a small, constant quantity of lubricating oil will enter the input gas stream as long as the pump is in operation.

Turnbuckle Anchors Dope Bucket to Floor

A dope bucket which can be picked up easily and moved when necessary, yet will "stay put" when in use despite the vibration that otherwise would cause an unattached unit to move about on the steel floor, is shown in the photograph.

Mounted on three pipe legs, the bucket's under side is equipped with a steel eye and turnbuckle, the latter hooked to another eye welded to the floor. Spotted at this point, and with several turns of the turnbuckle, the bucket thus is anchored firmly, with no possibility of its being knocked over.

By using a smaller container welded to the side of the larger one, a place is provided for the brush and results in less waste caused by the brush becoming overloaded.



BEFORE INSTALLATION OF INTERMITTER

AFTER INSTALLATION OF INTERMITTER

FIGURE 1—As may be seen on the chart before the intermitter was installed, during the first days of production the well was purged manually for 15 minutes. The well remained in good productive status until the third day when the gas production decreased as the result of liquid accumulation. This condition existed until the fifth day, when the well again was purged manually for 15 minutes. The production again was restricted on the sixth day and remained so until this chart was changed. The average production for this period was 90 Mcf per day. An intermitter was installed and set to automatically purge the well for 15-minute intervals equally spaced four times per day. The purging cycle was cut to twice per day on the third day and the same results were obtained. The average production for this period was 196 Mcf per day, or an increase of 117 percent.

TABLE 1—Results Obtained by Intermitters —Mesa Verde Wells

Well Name	GAS PRODUCTION, Mcf		
	Before	After	Percent Increase
Hughes 1-A	646	1,157	79.1
Hughes 5	239	259	8.4
Hughes 8	284	310	9.2
San Juan 28-7 6	83	107	28.9
San Juan 28-7 10	163	171	4.9
Stewart 5	90	196	117.0
San Juan 28-6 7	154	160	3.9
San Juan 28-6 56	976	1,084	11.0
Day 5-A	439	510	16.2
Hughes 5-A	532	594	11.7
Roelofs 3-A	560	622	11.1
Average			27.4

In the San Juan Basin . . .

Time-cycle intermitters, plunger-lifts boost output

By A. J. Dudenhoeffer, Assistant Division Gas Production Engineer
El Paso Natural Gas Company, Farmington, N. M.

EFFICIENT GAS WELL production in the San Juan Basin is maintained through use of intermitters and plunger-lift equipment used in various ways to fit individual well requirements. Liquid accumulation in the well bore and paraffin deposits in production tubing strings can be eliminated. Proper producing methods result in production increases ranging from 3.9 percent to as high as 212.5 percent.

The San Juan Basin is located in the northwestern part of New Mexico and the southwestern part of Colorado. The Mesa Verde formation is the major gas-producing formation in the San Juan Basin, with producing depths ranging from 4,500 to 6,500 feet. The Pictured Cliffs sandstone formation is the secondary gas-producing zone in the area. Here, producing depths range from 1,800 to 3,500 feet. Sand sections in both pro-

ducing horizons are fine-grained with average grain size of 0.10 millimeters.[1] Permeabilities range from 0.01 to 8 millidarcys, the average being 1 millidarcy. Due to this relatively low permeability, the majority of the wells drilled in the area require stimulation before commercial production can be obtained.[2] As of March, 1958, there were 3,439 producing wells in the basin. Of this figure, 1,416 are Mesa Verde producers and 2,023 are Pictured Cliffs producers.

Mesa Verde gas is gathered into a 500-psi line. Individual well production varies from 25 Mcf per day to 4,700 Mcf per day. Average daily production is 650 Mcf per day. Pictured Cliffs gas is gathered into a 250-psi line. Here, individual well production varies from as low as 10 Mcf per day to as high as 8,000 Mcf per day. The per-well average production is 400 Mcf per day. Net effective pay and permeability appear to be the chief factors governing volume production.

Problems. Liquid production from gas wells in the basin consists of distillate, oil and water. When the gas-to-liquid ratio reaches a certain point, the quantity of gas produced is not capable of lifting all well liquids to the surface against existing line pressures. This eventually causes the well to "log" up with liquids and restricts gas flow to the pipe line. In some cases production is shut off completely until the bottom-hole pressure builds up enough to lift the liquids to the surface. The well remains on a productive status until enough liquids again accumulate in the well bore to restrict gas production. Liquid production varies from 1-125 barrels per day. When a gas-liquid ratio is lower than 100,000 cubic feet per barrel, a well can be expected to give trouble insofar as loading up with liquids is concerned.

In localized areas, Mesa Verde production consists of crude oil with a high paraffin content. Accumulation of paraffin in the tubing restricts gas flow. In extreme cases paraffin deposits will completely plug the tubing if not removed.

Use of intermitters. A 1¼-inch tubing string, called a siphon or unloading string is commonly used in completion of Pictured Cliffs wells. Gas is produced to the sales line from the casing. Liquids that accumulate in the well bore are unloaded through the 1¼-inch string by use of a time-cycle controller operating a motor valve. As the motor valve is opened, the liquid accumulation is unloaded to atmosphere. This is commonly referred to as purging the well. In each instance where liquids are unloaded to the air, gas used to bring this liquid to the surface is wasted. A portable test separator has been equipped so that gas, liquid and pressure data can be determined during the operation and purging of a well. Knowing these factors, a suitable cycle using the least amount of gas to lift the water can be obtained.

Mesa Verde wells are equipped with a 2-inch tubing string which is used as the producing string. The ability of the well to lift all liquids coming into the well bore with the gas as it moves to the surface depends upon velocity of the gas stream and the amount and type of liquids produced. As the velocity of the gas moving to the surface decreases (as a result of drawdown in bottom-hole pressure), the pressure gradient in the tubing increases and reduces gas flow. So long as the formation is sufficiently competent, all that happens is that the bottom-hole pressure is raised, the production declines a little and the pressure gradient in the tubing becomes steeper.

This situation can progress to a point where the well will load up and die. The condition will continue to exist until the bottom-hole pressure increases to a point which will unload liquids against existing line pressures. This may occur in a period of a few hours to several days. The logging condition can be alleviated before the well actually dies by opening the well to atmosphere so that the enormous increase in velocity caused by the pressure drop will literally purge the tubing string and reduce its pressure gradient. The economic optimum fre-

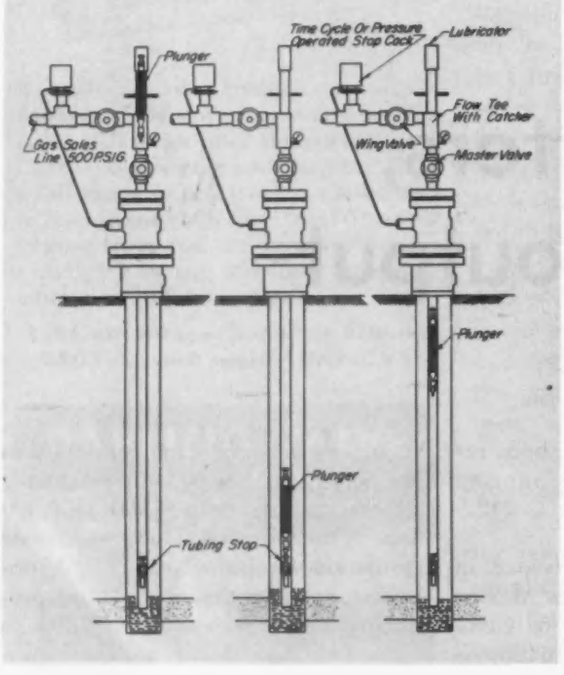


FIGURE 2—Drawing shows the most desirable type of plunger-lift installation as used in the San Juan Basin. Here, gas is produced through the tubing string to the 500 psig sales line. The plunger is inserted into the well by use of a lubricator. The time cycle controller with a motor valve shuts the flow line in and the plunger falls to the bottom of the tubing where a tubing stop previously has been set. At a predetermined time (ranging from 30 minutes to one hour) the surface controller will open the flow into the sales line. This brings the plunger (and liquids accumulated above plunger in the tubing string) to the surface. The flow of gas holds the plunger in the lubricator until next cycle is repeated by the surface controller. Determining best cycle is a trial and error proposition until optimum production is obtained.

About the Author

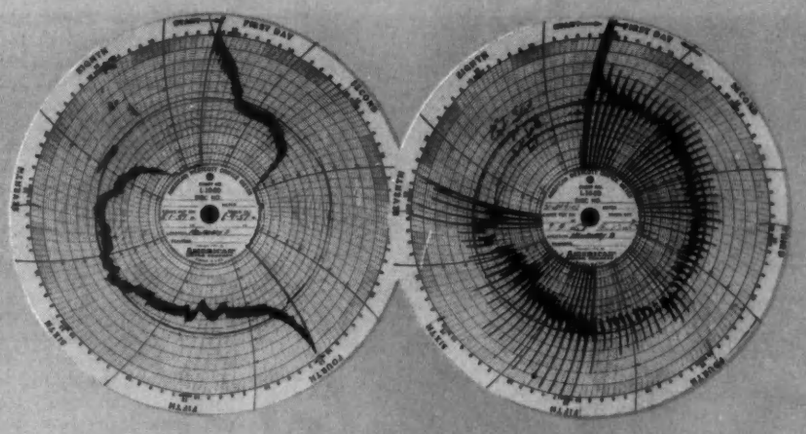
A. J. Dudenhoeffer graduated from Texas A&M College in 1951 with a B.S. degree in petroleum engineering. He worked for Baker & Taylor Drilling Company in the Hobbs area until 1952 and then served with the Corps of Engineers until 1954. He joined El Paso Natural Gas Company as a gas engineer and production engineer in the San Juan Basin and in 1957 was promoted to assistant division gas-production engineer.

quency of purging then becomes a compromise between the gas production loss resulting from the liquid accumulation and the quantity of gas used to get rid of the liquids.

The water lifting efficiency of the flowing gas in the tubing string is low, although gas velocity at the surface is high. The flowing gas velocity at the bottom of the well (where velocity is most needed) is low because of the pressure gradient and friction loss in the tubing, so that the pressure drop at the bottom of the well bore is not nearly as high as at the surface. Therefore, a very large slippage loss exists.

This is not the case where liquid hydrocarbons are produced. Where liquids are saleable hydrocarbons, they are collected in tanks on location. When the purging frequency becomes established, automatic time-cycle controllers or intermitters may be installed to perform the purging operation. Typical orifice meter charts showing the production cycle before and after intermitter installation are shown in Figure 1. Table 1 compares well performance before and after installation of the intermitters for purging purposes.

As may be seen from Table 1, the percentage increase from this production method ranged from 3.9 to 117 percent, with the average on the 11 wells tested being 27.4 percent. The amount of gas used to lift liquids in this operation varies from 5 Mcf per barrel to 10 Mcf per barrel.



BEFORE PLUNGER LIFT INSTALLATION AFTER PLUNGER LIFT INSTALLATION

FIGURE 3—These orifice meter charts show the improvement provided by the type of plunger-lift installation illustrated in Figure 2. Note the much more stabilized flow rate indicated in the chart taken after installation of the plunger-lift equipment. Gas production increased from 629 Mcf per day to 780 Mcf per day (24 percent increase) and liquid hydrocarbon production increased from one barrel per day to 1.5 barrels per day (50 percent increase).

TABLE 2—Gas and Liquid Production Through Tubing by Use of a Plunger Lift

WELL NAME	Gas Production, Mcf per Day			Hydrocarbon Production, Barrels per Day		
	Before	After	Percent Increase	Before	After	Percent Increase
Barrett 1	907	998	10.0	8.9	8.9	0.0
Barrett 2	1,061	1,149	8.3	8.1	9.8	21.0
Barrett 3	616	735	19.3	6.5	7.0	7.7
San Juan 32-9 1	577	705	22.2	15.3	16.6	8.5
San Juan 32-9 4	869	1,165	34.1	15.7	21.8	38.9
San Juan 32-9 5	841	946	12.5	14.1	18.8	33.3
San Juan 32-9 23	573	661	15.4	1.4	2.0	42.0
Scott 4	572	650	13.6	1.4	2.4	71.4
Scott 5	1,018	1,306	28.3	15.0	16.0	6.7
Marcotte 1	1,653	2,021	22.3	30.4	39.2	28.9
Riddle 2-C	1,000	1,145	14.5	5.6	7.0	25.0
San Juan 28-6 29	622	856	37.6	2.6	3.8	46.2
San Juan 32-9 37	591	826	39.7	*	*	....
San Juan 32-9 39	630	820	30.1	*	*	....
San Juan 32-9 41	1,204	1,435	19.1	*	*	....
Newberry 5	629	780	24.0	1.0	1.5	50.0
Average			21.9			29.2

* Liquid production not measured.

Plunger-lift installations. There have been several articles written on the theory and principle of operation for plunger lifts.[3, 4, 5, 6, 7] The most desirable type of installation applied to the San Juan Basin is shown in Figure 2. A typical orifice-meter chart of the plunger-lift type installation is shown in Figure 3. On this particular well, production before installation averaged 629 Mcf per day. After installation, production averaged 780 Mcf per day, or an increase of 24 percent per day. Table 2 is a summary of results from this type operation.

As may be seen from Table 2, the range of production increase is from 8.3 percent to 39.7 percent, the average being 21.9 percent. Liquid production increased 29.2 percent. Certain advantages obtained by this type operation are:

- Steady gas production is maintained without the waste of gas experienced by purging the well to atmosphere to unload liquids.
- The plunger acts as a scraper to keep tubing free of paraffin and other deposits.
- The necessity of cutting paraffin on a regular basis has been eliminated.

This type installation will not operate in all wells because of the slow buildup in bottom-hole pressure while shut in.

For wells that will not operate by this method, the procedure shown in Figure 4 (gas flow through casing, liquid flow through tubing) is used. Results obtained from this type of plunger-lift installations are summarized in Table 3. Increased production due to this method ranged from 6.8 to 212.5 percent. The average increase in daily production was 98.8 percent. Liquid production increased 79.5 percent.

Advantages of casing gas production over tubing gas production are are follows:

- Liquid accumlation and friction loss are held to a minimum, permitting higher gas-production rates which approach the theoretical maximum possible.
- Gas flow from the casing is at a lower velocity, and a much cleaner and drier gas is produced. Gas flow is not affected greatly by liquid cycles, with a resulting smooth flow of gas.
- Liquid-lifting efficiency is maintained at a high level. (The ratio ranges from 1.6 Mcf per barrel to 3.5 Mcf per barrel for a 5,000 ft. well.)[7]

New developments. Presently, a tubing dump valve developed in the San Juan Basin is working to the satisfaction of the operators con-

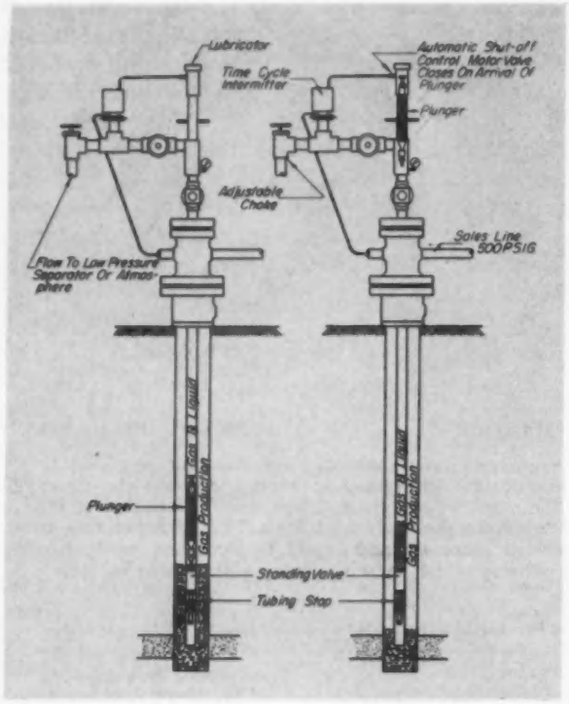


FIGURE 4—Here, gas is produced through the casing to the sales line. The annulus between the casing and tubing acts as a long separator with liquids accumulating at the bottom of the well bore. Through the use of a lubricator, time-cycle controller and choke, the plunger is cycled up and down the tubing. With a casing-tubing volume ratio in the order of five to one, a standing valve is used. With each trip of the plunger, the liquid is transferred from the casing to the tubing as a result of the differential pressure created as the plunger is moved to the surface. As the plunger enters the lubricator, the automatic shut-off control actuates the time-cycle controller, shutting off the flow of gas. The plunger then falls back to rest on the standing valve. The standing valve retains the liquid that has been moved into the tubing during the previous cycle. This liquid then is moved to the surface during the next cycle of the plunger.

TABLE 3—Gas Produced Through Casing, Liquids Through Tubing by Plunger Lift

WELL NAME	Gas Production, Mcf per Day			Hydrocarbon Production, Barrels per Day		
	Before	After	Percent Increase	Before	After	Percent Increase
Atlantic State 6	8	25	212.5	1.1	2.5	127.3
Barrett 4	294	388	32.0	3.5	4.2	20.0
San Juan 32-9 7	484	763	57.6	*	*	....
San Juan 32-9 17	92	141	53.3	1.0	2.0	100.0
Newberry 5	110	196	78.2	1.0	1.5	50.0
Jones 3-A	297	700	135.7	0.0	3.0	....
Stewart 3	96	205	113.5	0.0	1.0	....
Elliott 1-A	111	207	86.5	0.5	1.0	100.0
Case 3	88	94	6.8	0.0	1.0	....
Stewart 2-A	84	262	211.9	0.0	2.0	....
Average			98.8			79.5

* Liquid production not measured.

cerned. This valve is set in the bottom of the tubing above the tubing perforations and packed off. The tubing is vented to atmosphere. Gas is produced through the casing and liquid accumulation in the casing is permitted to enter the tubing through a small orifice. As hydrostatic pressure overcomes the spring setting on the valve, the valve opens and gas pressure then unloads the slug of liquid. As the weight of the liquid is removed, the valve closes and the cycle is repeated. As yet, no actual conclusions can be drawn from this method of production.

Conclusions. No direct over-all conclusions can be derived from the foregoing data because each well must be treated on an individual basis. Generally speaking, the following conclusions are valid:

- Intermitters perform satisfactorily on Pictured Cliffs wells.
- Intermitters must be used on Mesa Verde wells that are open-hole completions since these wells cannot be produced through casing.
- Mesa Verde wells producing above 500 Mcf per day that have trouble unloading liquids can be helped by use of a plunger-lift operation producing gas and liquid through the tubing. This method does not waste gas by blowing to atmosphere to remove liquids.
- Mesa Verde wells producing less than 500 Mcf per day that have trouble removing liquids (provided they are cased through the pay zone), can be helped by plunger-lift installation operating in the tubing. This method requires that gas used to lift the liquids be blown to the atmosphere, but the efficiency of lift is much greater than with intermitter applications.

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Why North Dakota is an oil-producing state

The Nesson Anticline has transformed North Dakota from a non-oil state into a 13-million-barrel-a-year producer within seven years. And the area's future looks just as bright as its past. At least 22 locations are now active, eight of which are being projected to test horizons below the main producing formation—the Madison. Also, predictions are that the anticline's present 75-mile north-south limits may well be extended to 100 miles. For the latest in the WORLD OIL series of technical reports on the nation's most promising oil areas, turn to Page 148.

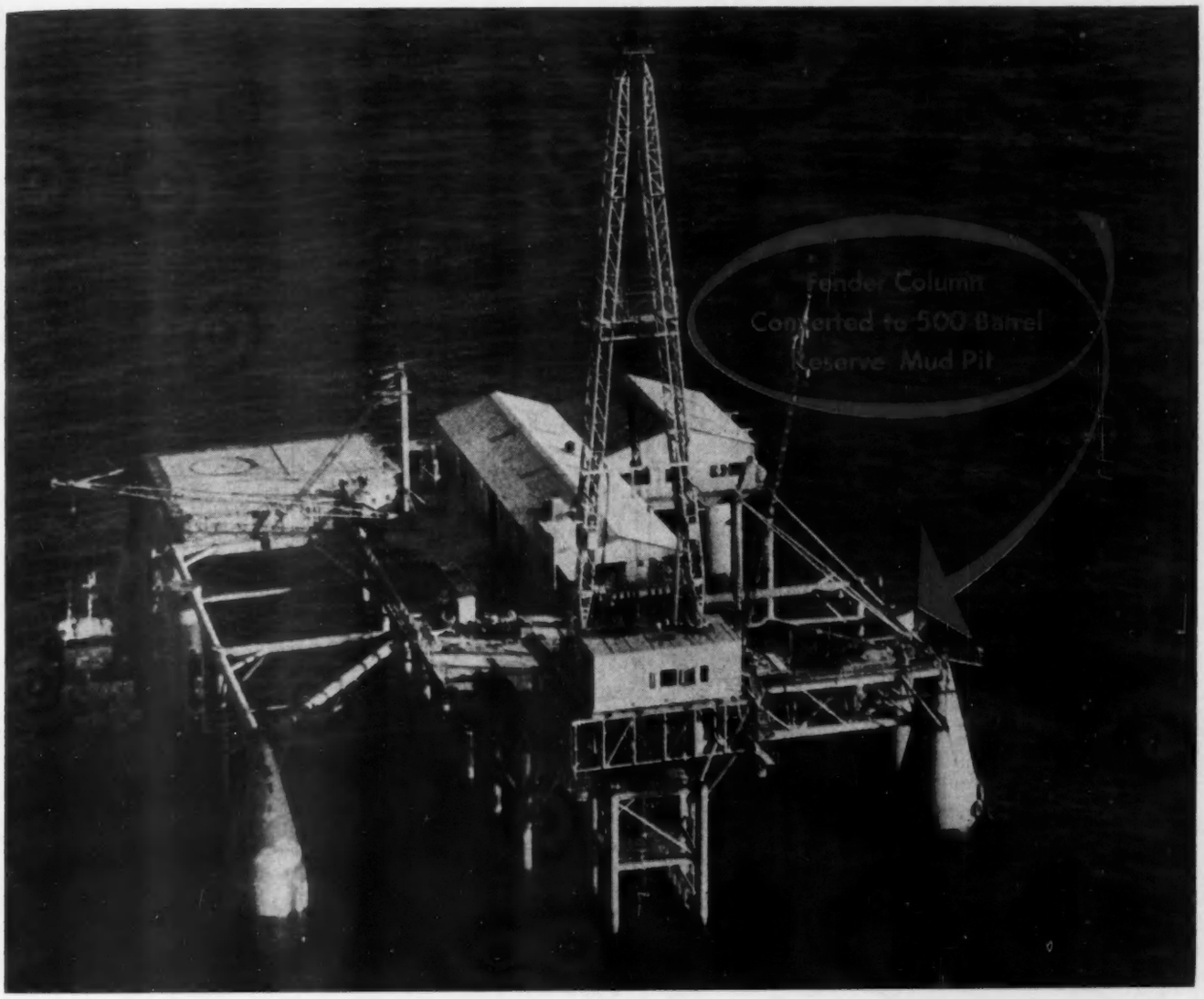


FIGURE 1—Kermac's Rig No. 46 is equipped with a 10-foot diameter fender column on both port and starboard sides of the barge structure. Fender column at right was converted to a 500-barrel reserve pit.

This offshore rig was equipped with . . .

Additional mud storage at nominal cost

Kerr-McGee Oil Industries Inc. successfully converted an integral structural part of their Rig No. 46 to a 500-barrel capacity reserve pit

By John Cox, Supervisor, Engineering and Maintenance
Kerr-McGee Oil Industries, Inc., Morgan City, and
Robert W. Scott, Engineering Editor, WORLD OIL

KERR-MCGEE OIL INDUSTRIES, INC. recently installed a unique liquid mud storage facility aboard their Rig No. 46, an offshore drilling barge. A 10-foot diameter fender column, an integral portion of the barge structure, was converted to liquid mud storage. An additional 500 barrels of storage was obtained at a nominal cost of $12,000.

Kermac engineers were faced with the problem of providing an additional 500 barrels of liquid mud storage aboard their Rig No. 46 (Figure 1). The lease operator (for which the

rig was drilling) had requested this storage in addition to the existing 800-barrel active storage due to possibly hazardous drilling conditions in the area.

Mud Tanks. Initially, additional conventional mud tanks were considered as a solution to the problem. These tanks were found unsuitable after evaluation indicated the following undesirable conditions:

- Installation of conventional tanks would reduce considerably the surface working area available to personnel on the rig.
- The barge structure was originally designed to support equipment installed at the time the unit was constructed. Since additional tanks would have to be designed for 18-20 pound mud, considerable bracing and structural work would be required to support this added weight.
- The over-all cost of the conventional installation would be prohibitive.

With the above facts in mind, attention was directed to the barge structure itself for a possible answer to the problem.

Fender Columns. Rig No. 46 is equipped with two "fender" columns which are an integral part of the barge structure. One column is located on the port side and the other on the starboard side of the structure. (Figure 2). The columns are 10 feet in diameter and extend from top to bottom of the barge.

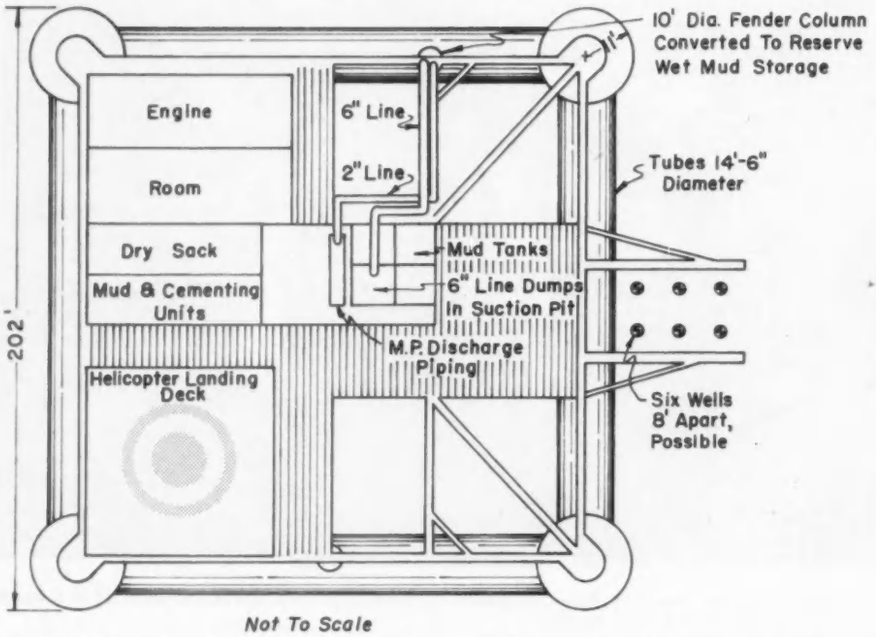
Since they were readily available, consideration was given to a means of converting the most accessible column to wet mud storage. Utilizing a column for storage presented several apparent advantages:

- No additional space would be required.
- A minimum of construction work would be required.
- Company maintenance personnel could complete the conversion on location.
- Cost of conversion would be a minimum compared to conventional mud tanks.

Although these advantages made the fender column conversion attractive, several serious problems were obvious.

Chief disadvantages of the conversion were:

- Some dependable means of transferring liquid mud from the column to the regular mud system had to be determined.
- Due to "settling out" properties, mud stored in the column would have to be provided with some means of constant agitation.



Not To Scale

FIGURE 2—This schematic layout of Rig No. 46 shows the piping arrangement required for the fender column conversion job. The 2-inch line is tied directly into the rig mixing pump manifold.

Conversion. After considering all possibilities, the fender column conversion appeared to be the most attractive alternative from an economic standpoint. Conversion procedures were as follows (Figure 3):

A conical steel "bottom" (⅜-inch wall thickness) was designed, built and installed at a point 45 feet below the top of the column. The "bottom" was equipped with a 6-inch drain line which extended through the wall of the column. A valve and reach rod were installed so that mud could be dumped when necessary. A clean-out many-way was installed in the column wall immediately above the cone bottom section.

A 6-inch re-circulating line was installed as shown in Figure 3. This line was manifolded to the transfer pump selected for the job so the pump could be used to agitate the mud.

A 2-inch submarine gun line also was installed. This line was equipped with three jets and connected to the rig mixing pump. The line was installed to provide a means of stirring the mud in event the combination agitator-transfer pump failed or was out of service for a sufficient length of time to allow mud to settle out. This line also is the "fill" line for the column. Mud is pumped from the main system by the mixing pump, through the line to the column for storage.

A deck section was welded into place 4 feet below the top of the fender column. The 4-foot recess provides a housing, preventing damage to the surface equipment by the rig boom which unloads material directly over the column. The deck is provided with an access hatch to the column (Figure 4).

Pumps. A 10-inch two stage, oil lubricated, deep well turbine pump was selected for the transfer and agitating requirement. The pump is equipped with cast iron fittings and powered by a 25-hp, a.c. electric motor.

The pump is installed in the column with the suction positioned approximately 4 inches above the cone bottom and hung from the upper deck. A 6-inch discharge hose connects the pump housing to the manifold system shown in Figure 4. The manifold system allows mud to be pumped di-

rectly to the main mud system or to be re-circulated through the fender column.

Two pumps were purchased for the installation. One is used in the column proper while the other serves as a stand-by unit. If a pump should happen to fail, it can be completely changed out in approximately three hours time.

An extended test period was initiated upon completion of the pump installation. In one instance, the pump was used for a total period of 40 days, 24 hours per day, without shutdown. Following this test, the assembly was removed from the column, disassembled and examined. Little wear was evident and no operational troubles were encountered during the test period.

Final cost figures are not available at this time. However, the entire installation including labor, welding, electrical work, all materials and two completely equipped pumps is estimated to have cost approximately $12,000.

Considering the problems involved, this is thought to be a most economical price for an additional 500-barrel reserve pit equipped for continuous agitation.

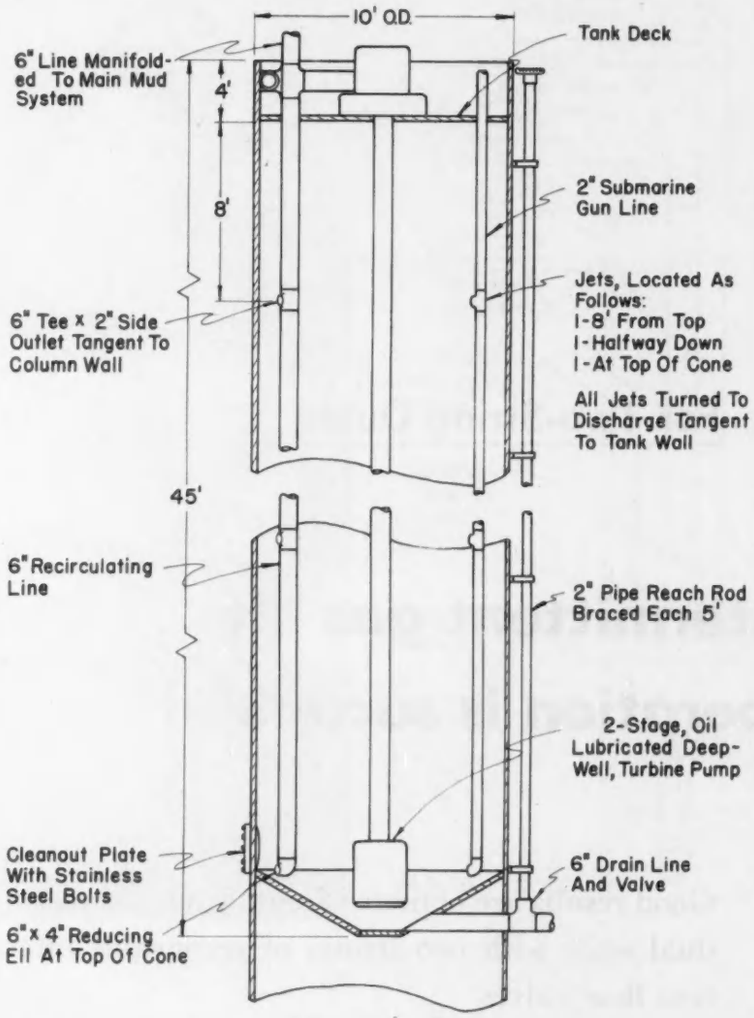

10' O.D.
Tank Deck
6" Line Manifolded To Main Mud System
4'
8'
2" Submarine Gun Line
Jets, Located As Follows:
1-8' From Top
1-Halfway Down
1-At Top Of Cone
All Jets Turned To Discharge Tangent To Tank Wall
6" Tee x 2" Side Outlet Tangent To Column Wall
45'
6" Recirculating Line
2" Pipe Reach Rod Braced Each 5'
2-Stage, Oil Lubricated Deep-Well, Turbine Pump
Cleanout Plate With Stainless Steel Bolts
6" Drain Line And Valve
6" x 4" Reducing Ell At Top Of Cone

FIGURE 3—Here is a schematic drawing of the converted fender column. The deep-well turbine pump is positioned approximately 4 inches above the conical bottom section. (Not to scale)

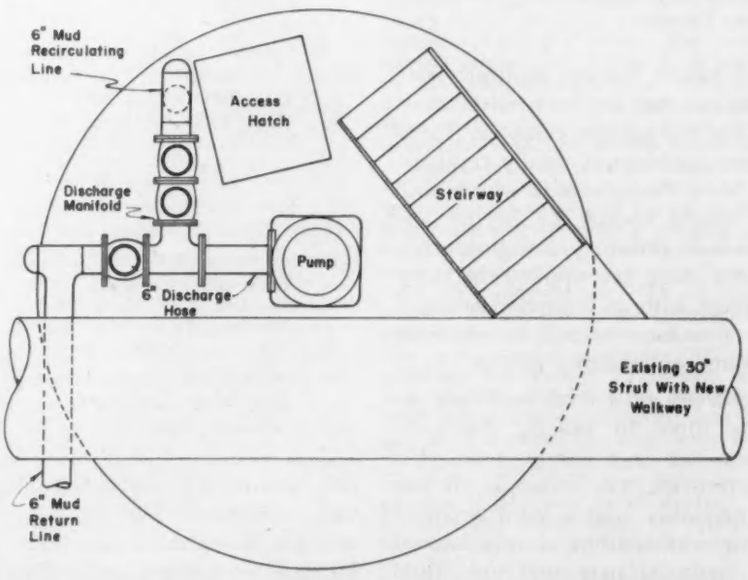


FIGURE 4—The layout of surface equipment and manifolding is shown here. The manifold system allows mud to be re-circulated through the fender column or to be pumped directly to the main mud system.

About the Author

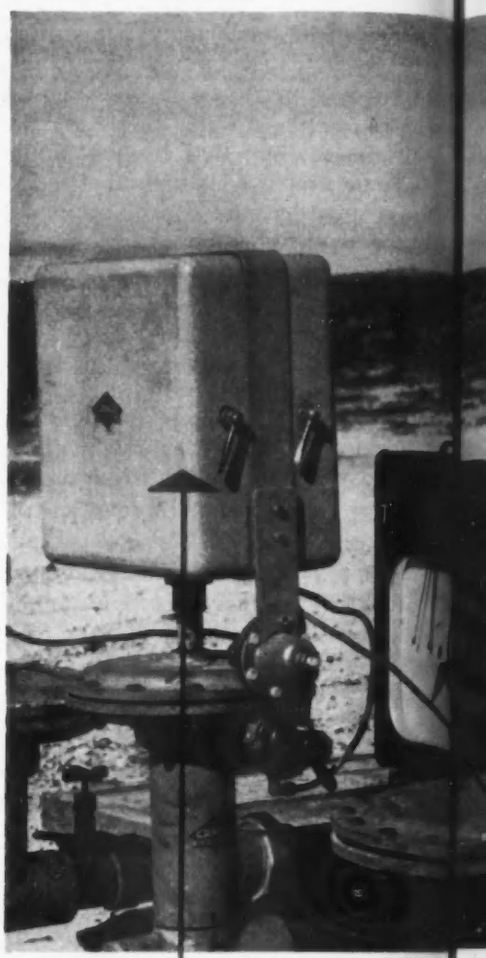
John W. Cox graduated from the University of Tulsa in 1950 with a B.S. degree in petroleum engineering. His first job in the oil industry was in the drilling division of Phillips Petroleum Company in the West Texas area. In 1953 he joined the Drilling Engineering staff of Kerr-McGee Oil Industries, Inc., in Oklahoma City. His present position with this company, in the Gulf Coast region, includes responsibilities as toolpusher, drilling engineer and supervisor of engineering and maintenance.

For Two-String Duals . . .

Intermittent gas lift operation is successful

Good results are obtained from lifting parallel string dual wells with two strings of retrievable intermittent flow valves

By William P. Massey
President, Camco Gas Lift Company
Odessa, Texas



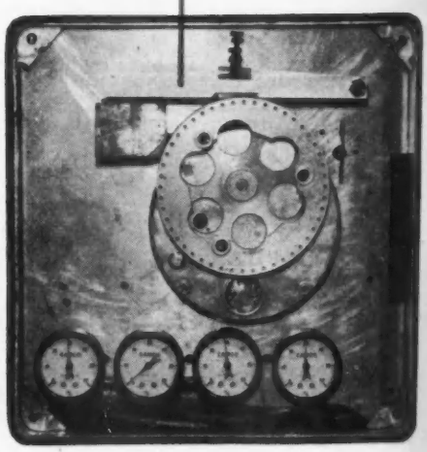


FIGURE 3

THE TREND toward multiple zone completions has not been without its problems. But a major company, faced with the problem of dually completing a West Texas well in which both zones would shortly be in the low bottom-hole pressure—low productivity index stage, has applied the latest techniques with an improved arrangement of surface controls to come up with some outstanding results.

Two zones of a dual well seldom will be lifted in exactly the same manner due to different reservoir characteristics. For example, it has been necessary that a dual be lifted using a combination of any two of three methods: intermittent, fluid operation or continuous flow. The zone to be produced intermittently should be categorized as follows:

High BHP—Low PI
High BHP—Medium PI
Medium BHP—Medium PI
Medium BHP—Low PI
Low BHP—High PI
Low BHP—Low PI

For the continuous flow method, the zone is categorized only as:

High BHP—Low PI
Medium BHP—Low PI
Medium BHP—Medium PI

For the continuous flow method, the zone is categorized only as:

High BHP—High PI

The intermittent process of lifting a dual well has found wide application because it is usable for almost all well conditions. The basic intermittent gas lift valve has been used satisfactorily for continuous flow by merely installing a sized choke in the surface gas line and leaving the surface intermitter open. It can be assumed that the intermittent process is most desirable for lifting both zones in all categories.

The big objection to the intermittent type of dual gas lift has been that the two intermittent valve strings in a dual well are incompatible when using the casing annulus as a common source of gas. Since bottom-hole pressure decline usually is inevitable, changing conditions can cause one

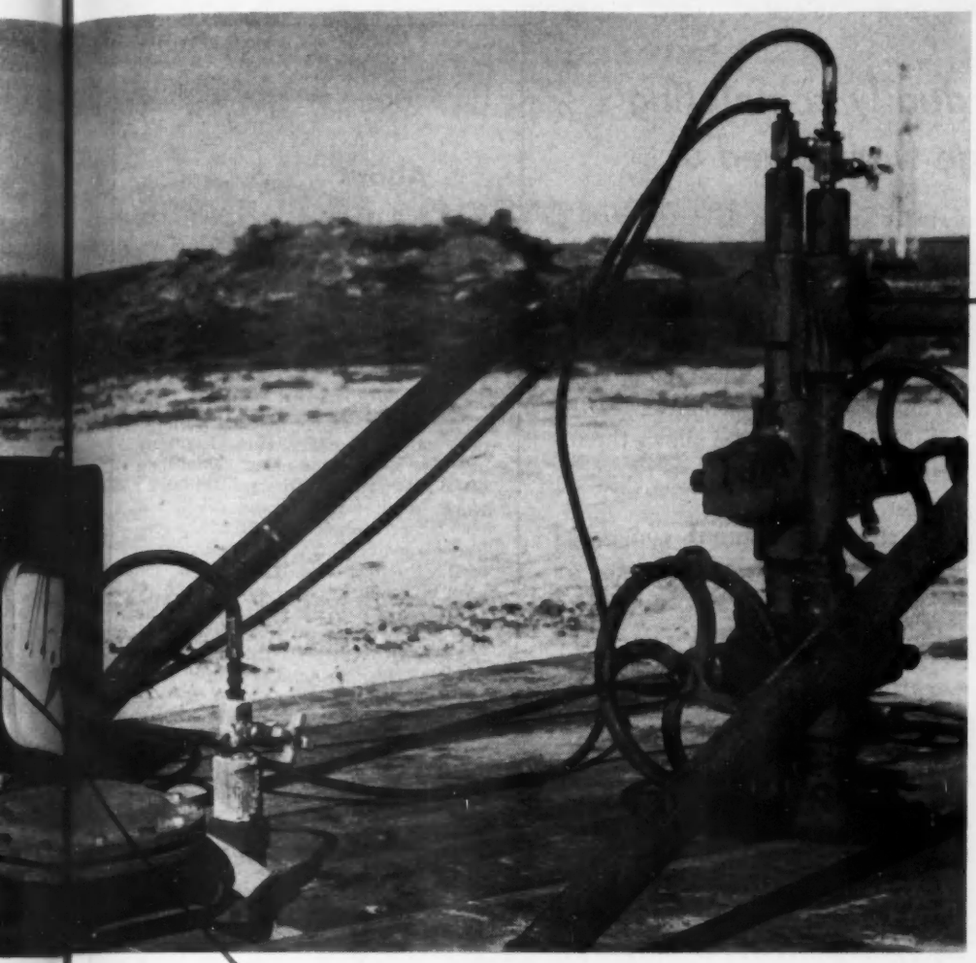


FIGURE 1

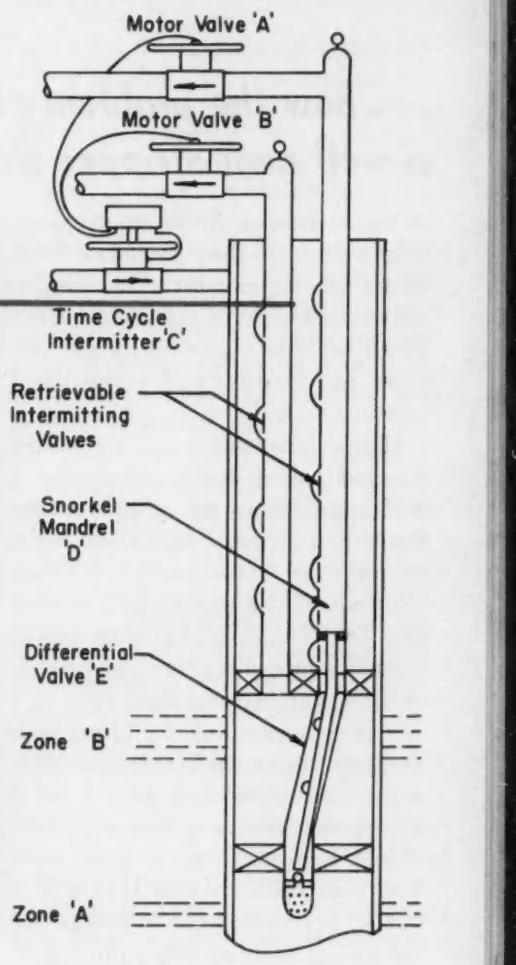


FIGURE 2

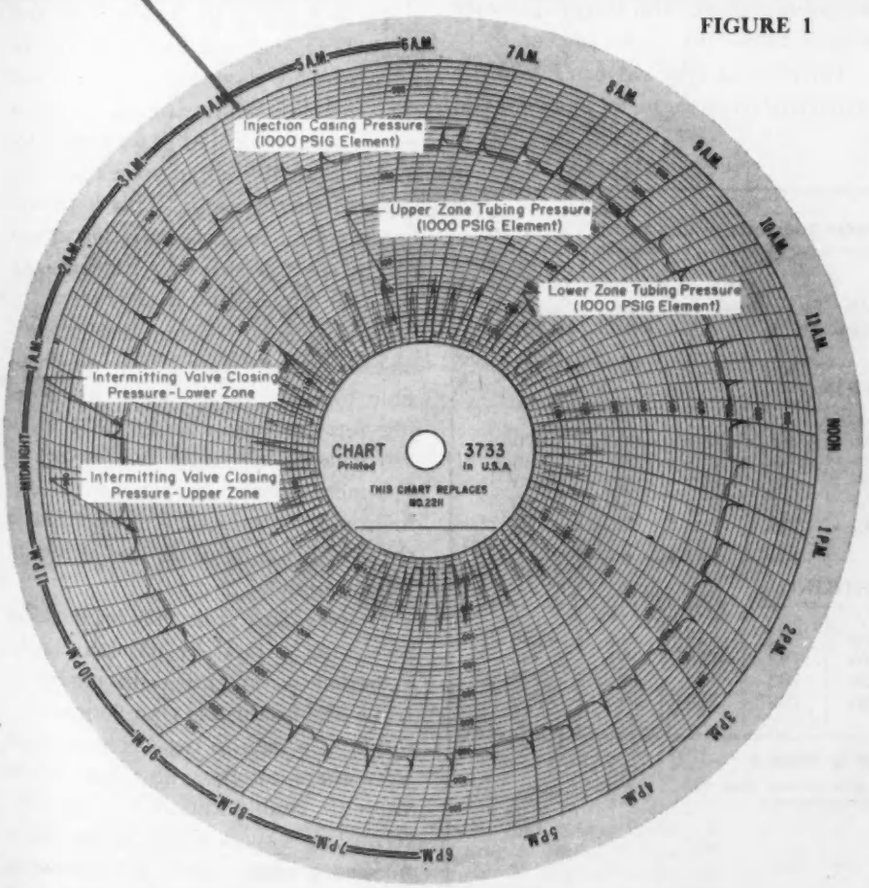


FIGURE 4

Figure 1 is an actual dual installation in West Texas showing the intermitter and flowline motor valve arrangement necessary for two-string intermittent operation. The intermitter pilot (center) also operates the flow line valves. The schematic drawing (Figure 2) shows equipment necessary for a two-string dual well with intermitting gas lift valves. The multiple control intermitter (Figure 3) is operated by the pilot arrangement shown here. Three bleed orifices and pivot arms and a three-section timer wheel control the gas intermitter valve and flowline motor valves. A typical pressure recorder chart (Figure 4) shows casing injection pressures along with closing pressures of operating valves. It is noted that the closing pressure of the lower zone operating valve declines to the same pressure as the upper zone operating valve after approximately 15 minutes has elapsed. This is due to the opening of the motor valve on the upper zone flow line. The lower zone is producing 205 barrels of oil per day through 2 1/16-inch tubing. The operating valve for this interval is at 5,440 feet. Valve operating pressure is 860 psig at 60 degrees. The upper zone is producing 172 bopd. The operating valve for this string is at 5,385 feet. Valve opening pressure is 840 psig at 60 degrees. Both intervals are being lifted by retrievable, intermitting pressure-operated valves.

. . . how the problem of dually completing a well near stripper stage was solved . . .

string to have a lower injection or producing level than the other. This means thiefing of most of the gas by one zone and high gas input ratios. The other zone is starved for gas and does not produce the required amount of fluid.

Here's how this company solved the problem of dually completing a well approaching the stripper stage. Gas injection was controlled by a regular time cycle controller which also controlled a motor valve on each flow line. The flow line motor valves normally open, allowing static buildup of each zone between injections.

The complete cycle for lifting both zones intermittently is as follows (Figure 1 and 2): Motor valves *A* and *B* are open, allowing producing Zones *A* and *B* to build up to static level. The time cycle intermitter *(C)* is closed, preventing gas injection into the casing annulus. When intermitter *(C)* opens for a short period of gas injection, motor valve *B* closes, being actuated by gas intermitter *C*. Motor valve *B* remains closed for a longer period of time than the gas injection period. This directs gas through the valve to lift Zone *A* only. Motor valve *B* opens after the fluid slug from Zone *A* reaches the surface. The next gas injection period closes motor valve *A*, and Zone *B* is produced in the same manner. Figure 3 shows the intermitter mechanism.

Subsurface equipment consists of wireline retrievable intermittent type valves in full-opening, side-pocket mandrels.

The depth of the lower zone usually is several hundred feet below the upper zone. It is necessary to separate the two producing zones, and isolate the gas in the annulus from the upper zone. This is accomplished by using two packers. Gas for the lower Zone *A* is directed through the bottom valve, which is contained by a snorkel-type mandrel *D*, into the annulus between marconi and larger diameter tubing below the upper packer.

Differential type valves *(E)* on the marconi string serve to unload as in a regular chamber. Between gas injections, they serve to vent gas from the small annulus area into the marconi, allowing a fluid buildup in both areas.

Table 1 shows the closing pressure analysis on the intermitting valves for a two-string dual installation. Note that the closing pressure of the lower zone operating valve is purposely set higher than the upper zone operating valve closing pressure. This is to prevent loading the accumulation chamber in the lower zone with gas each time the upper zone is produced.

Old wells are being dually completed in many cases. It is now possible to make dual completion wireline retrievable gas lift installations in 5½-inch casing using two strings of 1½-inch tubing, one string of 1½-inch and the other 2 1/16-inch, or in the 7-inch casing using two strings of 2-inch tubing.

It is evident that this principle of producing a dual by gas lift can be extended or magnified in regard to triple and quadruple completions. Addition of a cam to the gas intermitter to actuate another flow line motor valve for each additional string of intermitting valves in the same well is necessary along with an additional packer down hole. —**The End**

TABLE I—Closing Pressure Analysis On Dual Intermitting Strings

Port Size (Inches)	(1-AV/AB) %	Pv-0 @ 60° In PSIG	Depth In Feet	Tv @ D In °F.	Pb @ 60° In PSIG	Pb @ D In PSIG	Pv-C @ Surface In PSIG
LONG STRING							
3/16	.906	950	2731	94	860	925	870
3/16	.906	930	3877	98	840	910	835
3/16	.906	910	4750	103	825	900	810
3/16	.906	890	5406	108	805	890	790
1/4	.836	860	5440	108	720	795	705
SHORT STRING							
3/16	.906	910	2673	94	825	885	830
3/16	.906	890	3840	98	805	875	805
3/16	.906	870	4708	103	790	860	775
1/4	.836	840	5385	108	705	780	690

DEFINITION OF SYMBOLS

AV/AB — Ratio of Port Area with Bevel to Effective Bellows Area (%).
Pv-0 — Opening Pressure of Valve with Zero Tubing Pressure.
Tv @ D — Temperature in Well at Valve Depth.
Pb — Charge Pressure Inside Bellows.
PV-C — Closing Pressure of Valve—PSI.
PSIG — Pressure Per Square Inch Gage.
D — Depth.

About the Author

William P. (Pat) Massey is president of Camco Gas Lift Company of Odessa, Texas. He left Oklahoma after graduation from high school to work in the East Texas oil fields. He later studied hydraulics engineering at Massachusetts Institute of Technology and has been in the gas lift business for 17 years. He is a member of API and AIME. He was author of the article "Gas Lifting Deep Wells in the Permian Basin" in the September, 1950, issue of WORLD OIL.

Here's how one Canadian operator is using . . .

Chemical control of H_2S during drillstem tests

By J. U. Messenger, Safety Engineer
Mobil Oil of Canada, Ltd., Calgary

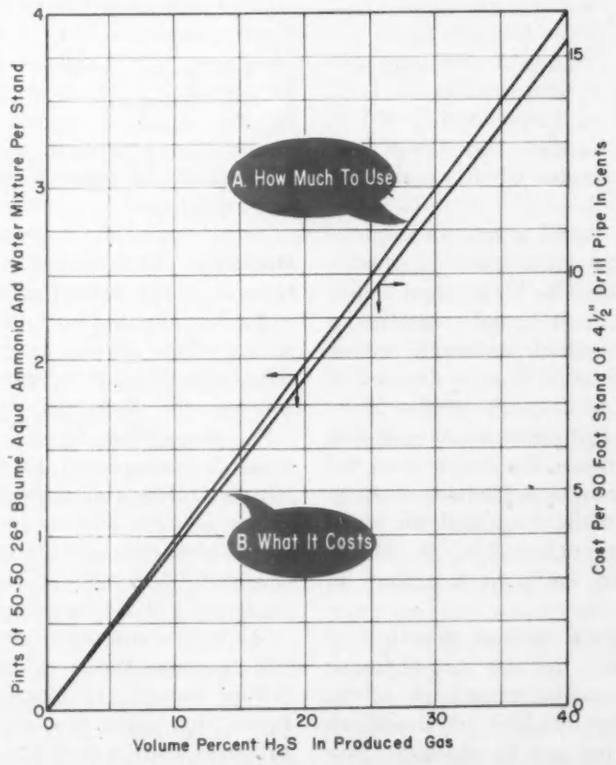
CHEMICAL CONTROL of H_2S during drillstem testing operations of wells containing sour gas or hydrogen sulfide has proved effective in Canada. The techique may be applied wherever such conditions occur. Concentrations of hydrogen sulfide are known to range from zero to 40 volume-percent and, in instances, have resulted in fatalities. In 1957 four deaths and 100 exposures were reported in drilling wells in Alberta, Canada.

Recently, ammonium hydroxide (also called aqua ammonia and ammonia solution) was used to neutralize hydrogen sulfide in drill pipe after a drillstem test of the Mobil Oil of Canada, Ltd., Wimborne 13-14. Ammonium hydroxide solution was selected in preference to sodium hydroxide solution because it will neutralize hydrogen sulfide both in solution and in the vapor phase. Free ammonia gas boils off a concentrated solution and reacts with free hydrogen sulfide gas.

During a typical drillstem test in a deep well, a water cushion usually is employed. The produced sour gas bubbles through this water cushion, saturating it with hydrogen sulfide. Finally, hydrogen sulfide is produced with the gas leaving the string full of poisonous gas and water. In some instances, the gas blow is sufficiently strong to blow the water cushion out of the drill pipe. This leaves the string full of gas as it would be if no cushion were used. Under ordinary circumstances pressure is removed from the drillstem and the pipe is pulled from the hole once the DST has been completed. Each stand of drill pipe contains dangerous quantities of hydrogen sulfide. Once the water cushion is encountered, the release of pressure will cause a blow. While a mud box is used to deliver the hydrogen sulfide saturated water to the sump, a considerable quantity escapes and runs under the rig. In wintertime, this water freezes. Hydrogen sulfide gas is released in lethal concentrations during subsequent periods of warm weather. This also is true of waters delivered to the pump. Crewmen have been overcome or killed by hydrogen sulfide from these two sources.

Hazards increase. During withdrawal of the drill pipe, the hazards on the rig floor are even more severe. Small canister-type gas masks containing activated charcoal have been used but have not been entirely effective. Recently, gas masks which have a forced air supply have been used and provide adequate protection. These masks weigh 39 pounds. While they provide effective protection, they are cumbersome and delay operations. The cost for compressed air for a single hole can run as high as $500. By removing the H_2S from the drillstem by chemical means, it is not necessary for crews to wear gas masks. Men are more comfortable and trips safer, faster and cheaper.

An ammonium hydroxide solution prepared by diluting 26 degree Baumé aqua ammonia with one part water was administered by pouring the solution down the drill pipe in Mobil Oil Wimborne 13-14. A hydrogen sulfide detector was used to detect the gas. Before application of aqua ammonia, the hydrogen sulfide was so strong it could not be measured. After treatment, 10 "sniffs" showed no residual hydrogen sulfide. Residual ammonia gas was removed com-



Curve A shows the amount of aqua ammonia necessary to neutralize varying amounts of hydrogen sulfide in 4½-inch drill pipe. Curve B indicates the cost in cents per stand for applying the ammonia treatment to different concentrations of H_2S.

ACKNOWLEDGMENT

This article based on a paper presented at the Ninth Annual Technical Meeting, CIMP&NG Division, Calgary, Albt., Canada, May 28-30, 1958. The authors acknowledge the cooperation of Mobil Rig 3 crews and other Drilling department personnel in running these tests. The assistance of E. Thurston and A. MacNeill in reviewing the process in reference to its use on a rig also is acknowledged.

pletely by washing the drillstem with water. No ammonia could be detected by smell. After this treatment, the drill pipe being pulled was racked completely free of either ammonia or hydrogen sulfide gas.

When the liquid portions of the drillstem test were encountered, it was not possible to neutralize the hydrogen sulfide by pouring ammonia solution down the drill pipe. The crew then had to wear gas masks to be safe. However, as the stands were set back, ammonia was poured into the drill pipe from the top and the hydrogen sulfide remaining was effectively neutralized.

On the basis of this and several subsequent tests, there are two methods of applying aqua ammonia which are safe and effective. In the first method, aqua ammonia is applied to drill pipe containing sour gas but no liquid. A pump-out sub is included in the string and opened when liquid is encountered. The noxious liquids then are pumped into the test pit. In the second method, aqua ammonia is applied to drill pipe containing sour gas but no liquid. Gas masks are worn when liquid is encountered. Aqua ammonia is used to neutralize residual H_2S in the drained drill pipe after it has been racked.

Pump-out subs have not been too successful in clearing pipe after a drillstem test. It is believed that this is caused by opening the sub while the pipe is still on bottom and relatively void of liquids. The uncontrolled drop of the mud column against little or no head pulls the hole in and causes bridges. Circulation is lost above these bridges when an attempt is made to reverse out with the mud pumps.

If ammonia solution were applied so that the pipe could be pulled safely until liquid is encountered, this surge could be controlled by connecting the drill pipe to the flare pit through a suitable valve. A mud gun could be left open so that excessive pressures could not be reached rapidly. A constant safe pressure of 50 to 200 psi could be maintained on the annulus while reversing out. Under these conditions, the top hole would not be broken down and bridges would be less likely to form. Also, samples for geological survey could be obtained accurately. The poisonous liquids would be delivered to the flare pit which is a safe distance from the rig.

About the Author

Joseph U. Messenger is employed by Mobil Oil of Canada, Ltd., Calgary, Alberta, Canada, as a chemical engineer. He has been working on drilling muds, cements, lost circulation, corrosion, injection waters, and chemical problems associated with these fields. Messenger received his M.S. degree in physical and inorganic chemistry in 1942 from the University of Southern California. He is a member of the American Chemical Society and the National Association of Corrosion Engineers.

Example. An example of the second procedure, assuming the gas contained 35 volume-percent H_2S, follows. Although it is operative, this procedure is inferior to the first.

1. Prepare a 50-50 solution of aqua ammonia by adding an equal volume of water to the 26 degree Baumé solution from the drum.

2. Pour four gallons of this solution down the drill pipe.

3. Wash residual ammonia from drill pipe with the wash-up hose.

4. Pull 12 stands of drill pipe and apply another treatment as in 1, 2, and 3, and so forth until liquid is encountered. (Also, these first four steps are applicable when a pump-out sub is used.)

5. When liquid is encountered in the drill pipe, crew members should use gas masks. The liquid then would be dumped in the usual manner. To neutralize residual hydrogen sulfide in the stands of drill pipe drained of liquid, 1½ to 2 quarts of the 50-50 ammonium hydroxide solution should be poured down the stand from the top. If ammonia seeps out of these stands on to the floor and the smell becomes objectionable, it can be washed away easily by a stream of water.

6. Using this method, the trip into the hole after the test can be made without gas masks in complete safety. Also, usually one-half to two-thirds of the trip out can be so made. Savings in rig time and compressed air will offset easily the cost of the ammonia solution. This cost has been calculated to be 11.55 cents per stand at a 100 percent margin of safety.

To allow the drill pipe to breathe, it might be desirable to rack the drill pipe to permit air circulation. Since both water vapor and ammonia are lighter than air, residual ammonia would float gradually from the drill pipe. However, trapping the ammonia solution in the bottom of the drill pipe would ensure neutralization of hydrogen sulfide vapors at the point where contact by the crew would be most likely.

In very cold weather, a reduced amount of ammonia gas would be given off by ammonia solutions. Under these circumstances, ammonia solution should be poured into the drill pipe before it has a chance to become very cold (or undiluted ammonia solution used.)

It should be emphasized that the previously described method of neutralizing H_2S is absolutely safe so long as gas alone is present in the drill pipe. However, as soon as liquid is encountered (if the second method were being used) gas mask protection would be necessary. This method has been discussed with drilling personnel. There is no known instance (when a plug valve is being used) where an uncontrolled "blow" occurred until a wet stand was broken off. Also, sounding the pipe is an effective method of determining whether the pipe is "wet" or "dry". *Each stand should be sounded before it is broken out.* As the liquid is approached, more ammonium hydroxide solution may be required because of gases boiling from the liquid.

Hazards. There are three possible hazards in the second method:

1. Rig crews may not wear gas masks when liquid is encountered. They would not be protected from an unexpected "blow."

2. Ammonium hydroxide solution must be transported to the monkey board. Unless a suitably rugged container is used and securely fastened to the elevators, a container might be dropped. Crews should remain off the rig floor until the container is secured.

3. Under the conditions used, it is felt that ammonia cannot create a poison hazard. It must be remembered that ammonia should not be breathed over extended periods of time. Unlike hydrogen sulfide, harmful concentrations of ammonia always will be indicated by a sharp smell.

—The End

Are diesel-electric rigs performing properly?

Progress is being made through joint efforts of drilling contractors and electrical equipment manufacturers. Recording devices were used to test this West Texas well

By Bryant Trenary, Equipment Sales Engineer
General Electric Company, Dallas

DIESEL-ELECTRIC RIGS are becoming more prevalent in the drilling industry. With continuing interest in this field of application, electrical equipment manufacturers are conducting extensive operational tests to evaluate their equipment performances.

In May 1957, Great Western Drilling Company assembled an all diesel-electric rig. The power plant included three generators. Two generators were assigned to the drawworks motor No. 1 and the third to drawworks motor No. 2. Each generator was powered by two turbo-charged diesel engines. This rig was first placed into operation with the drilling of Phillips Petroleum Company's Montgomery A-1 in Pecos County, Texas.

This well was spudded on July 10, 1957, and a year later, July 8, 1958, a depth of 23,000 feet was reached without any downtime due to malfunction or failure of the electrical equipment. This was largely the result of several months of advance planning.

On July 9, 1958, the electrical equipment manufacturing company conducted an evaluation of its electrical equipment by observing instruments that were placed on the equipment. Those instruments recorded the amps and volts of the various motors and generators on the rig during the hoisting and drilling operations.

Hoisting operation. On July 9, 1958, the driller started out of the hole with 23,000 feet of drill pipe. A typical section of the recording tape on the second stand that was pulled is shown in Figure 1. Each vertical line on the tape represents 10 seconds. At point *A*, the drive clutch was engaged by the driller with the motors rotating slowly. At point *B*, the driller advanced the throttle to full power, and the load began to accelerate, reaching its maximum velocity at point *C* and then slowing down apparently to an increased load caused by the hydraulic action of the fluid in the hole. At point *D*, the driller released the drum clutch and applied the mechanical brake to stop the load. At point *E*, the throttle was released back to a low idling speed. The motor with two generators assigned delivered 1,078 horsepower at its peak during this cycle. The total power delivered by the two motors was approximately 1,600 hp.

Figure 2 shows the same hoisting cycle for the thirteenth stand coming off bottom. Point *A* records the value of amps required to break out the pipe with the pipe tongs.

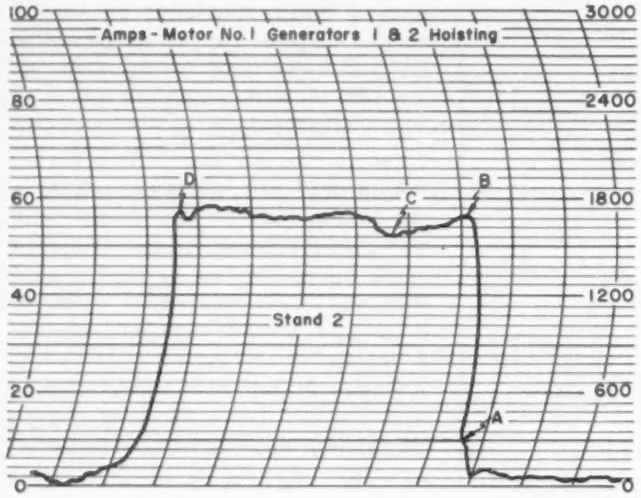
The thirteenth stand, by stopwatch reading, took 15 seconds to accelerate to full speed. The hoisting motion continued for 43 additional seconds at full speed for a total hoisting time of 58 seconds for the thirteenth 90-foot stand of drill pipe.

Figures 3 and 4 show the recorded amp and voltage values for stands 75 and 76. A total of 40 seconds was noted for the pulling of each stand. Figure 5 shows that less than 30 seconds was necessary to pull stands 146 and 147.

Figure 6 shows the load amps between stands 198 and 199 where the driller changed mechanical transmission ratios in his drawworks. After analyzing this section of the report, it was noted that additional stands could have been hoisted prior to changing transmission ratio. It was felt that this transmission change was not necessary until the flat portion of the curve had reached a value somewhere near 800. Hoisting time requirements for the two stands in different transmission ratios would have been identical. As it was, three seconds were lost per stand for a few stands because of changing the transmission ratio too soon.

Rotary table drive. Figure 7 is a record of the rotary table in operation. This chart was recorded at a depth of 22,988 feet. At this point, the rotary was turning at 38 rpm and requiring approximately 34.3 hp.

Pump drive. Figure 8 is a recording of the pumping operation. A 700 mechanical horsepower pump was operating at a surface pressure of 2,000 pounds per square inch, 53 strokes per minute and equipped with 5½-inch



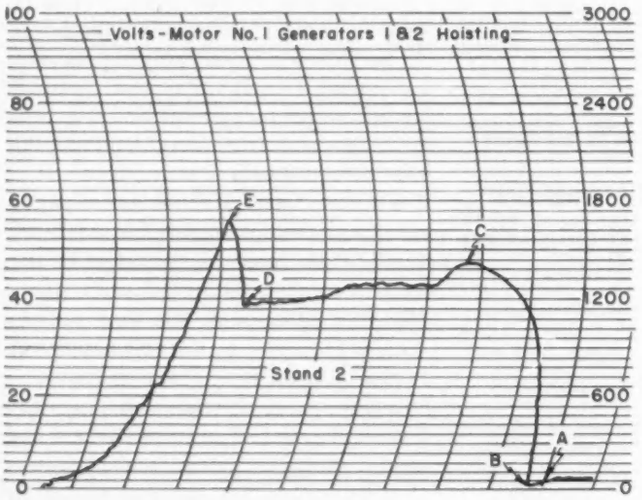


FIGURE 1—Recording tapes are used to record electrical equipment results on Great Western Drilling Co. diesel electric rig operating in Pecos County, Texas.

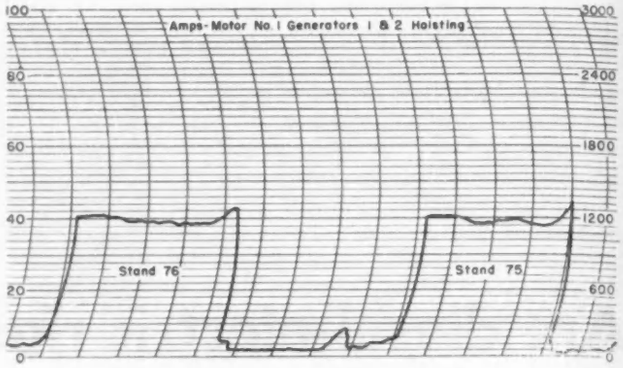


FIGURE 3

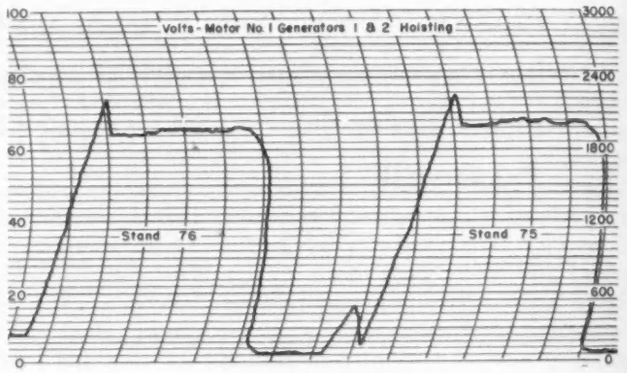


FIGURE 4

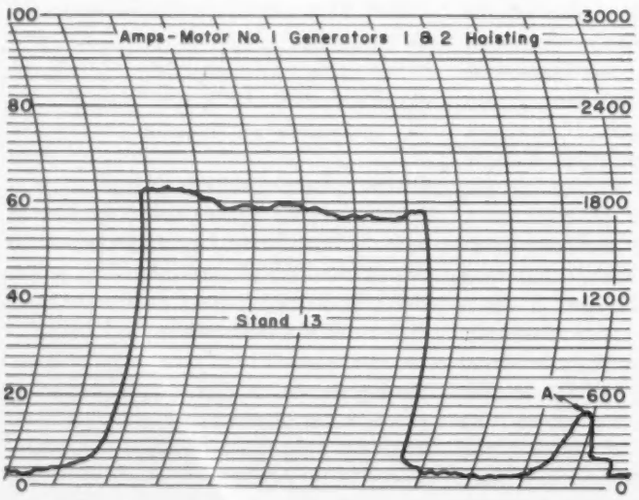


FIGURE 2—A total time of 58 seconds was recorded for hoisting the thirteenth stand of drill pipe.

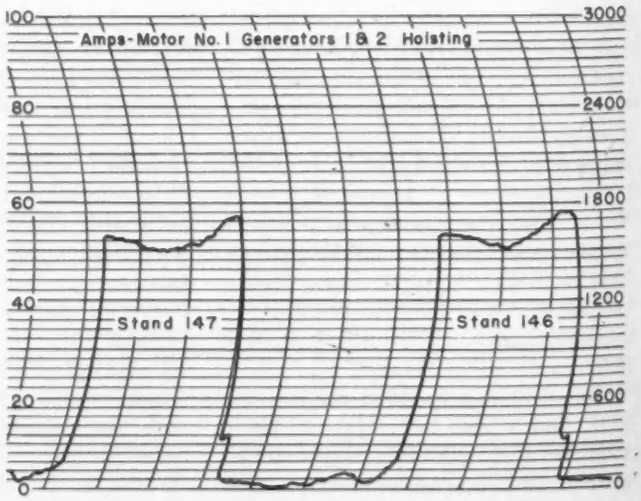


FIGURE 5—Recording charts show where the hoisting time is decreased as the drill pipe is pulled from the hole.

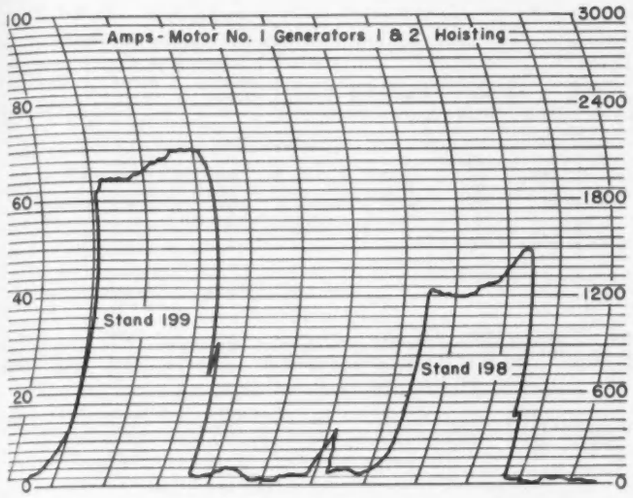
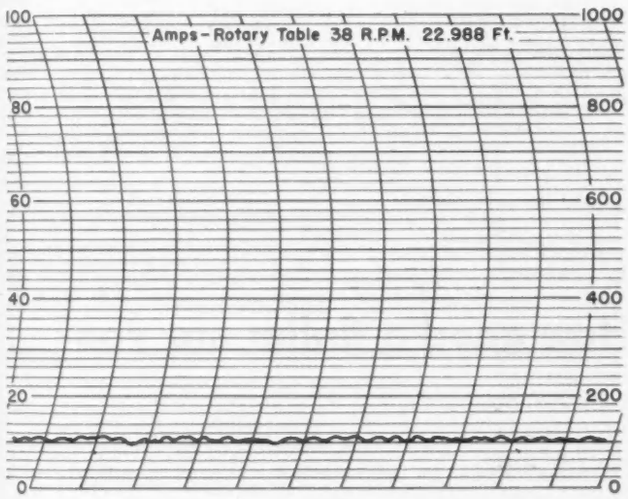


FIGURE 6—Recording charts are useful in ascertaining the most efficient transmission ratio for hoisting drill pipe.



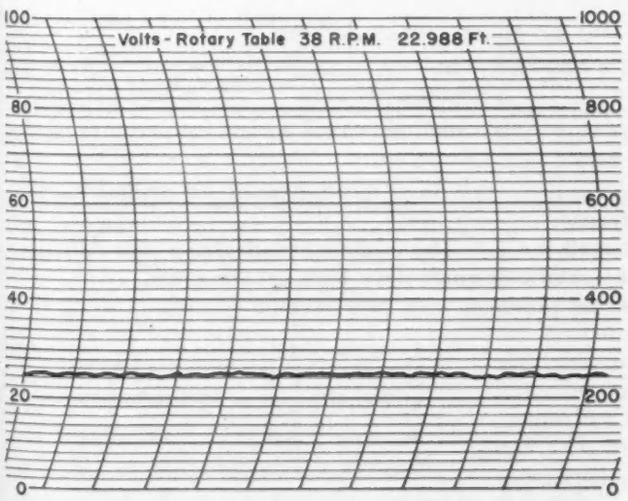
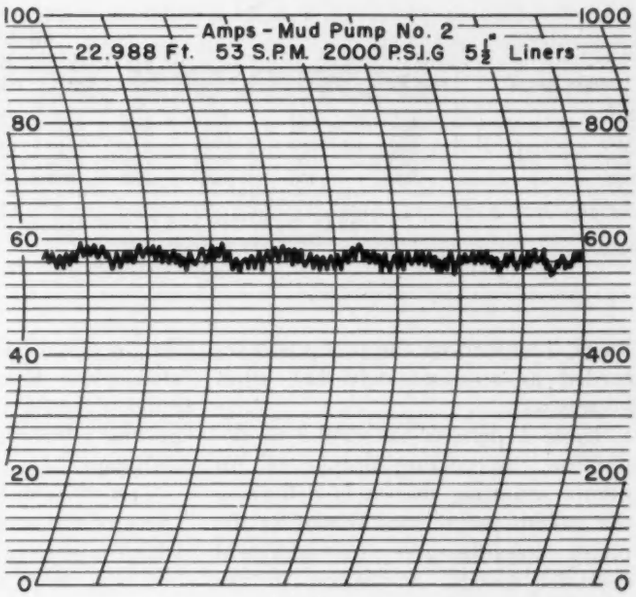


FIGURE 7—Rotary operation may be adequately recorded as shown above.



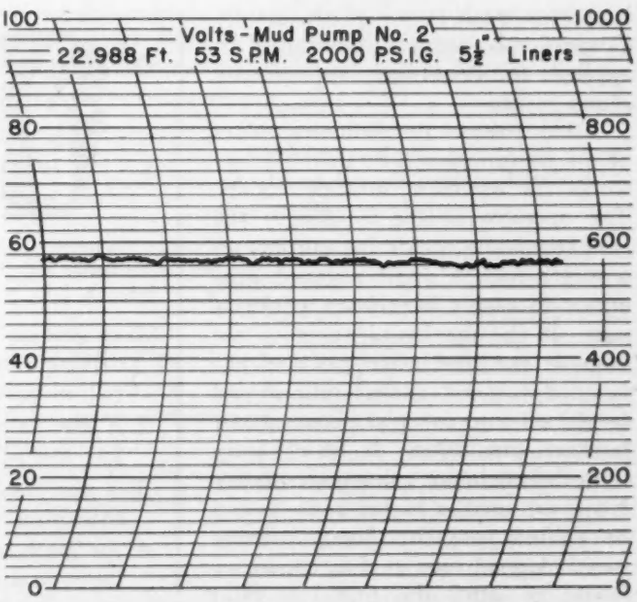


FIGURE 8—Charts, if properly used and evaluated, are of great importance in maintaining efficient pumping operations.

TABLE 1

METER VOLTS (Same)	Motor RPM	Pump SPM	VOLUME—GPM 8 Inch	7½ Inch	7 Inch	6½ Inch	6 Inch	5½ Inch
675	973	65	852	742	640	644	456	374
630	897	60	787	685	591	502	421	347
570	823	55	721	628	541	460	386	317
520	748	50	655	571	492	418	351	789
470	673	45	590	514	443	377	316	259
420	598	40	524	457	394	335	280	231
380	523	35	458	400	345	293	245	202
325	448	30	393	342	296	251	210	173

Average Amps	METER Minimum-Maximum	Motor Torque	PRESSURE—PSIG 5½ Inch	6 Inch	6½ Inch	7 Inch	7½ Inch	8 Inch
845	770 — 920	3790	2727	2236	1875	1593	1374	1197
760	585 — 835	3480	2500	2045	1720	1460	1260	1097
595	520 — 670	2780	2000	1640	1375	1170	1010	877
445	270 — 520	2080	1500	1230	1030	875	756	658
380	205 — 455	1390	1000	820	688	585	505	438

GREAT WESTERN DRLG. CO. RIG 44
27 Tooth Sprocket on Motor
80 Tooth Sprocket on Pump

TABLE 2

VOLTS	Motor RPM	Rotary RPM High	Rotary RPM Low
0	0	0	0
155	200	38.6	20.6
290	400	77.2	41.2
420	600	116.0	61.6
555	800	154.5	82.2
695	1000	193.0	103.0
770	1090	210.0	112.0

AMPS	Motor Torque	Rotary Torque High	Rotary Torque Low
100	475	2460	4630
200	950	4915	9250
300	1400	7250	13600
430	2000	10380	19500
750	3460	17900	33650
890	4020	20800	39100
970	4400	22800	42800
1020	4680	24250	45450
1090	4900	25400	47700

liners. The load on the pump was recorded as approximately 417 input horsepower.

Table 1 permits the driller to determine the volume output of his pump, assuming that it is delivering the gallons per minute shown by the pump manufacturer for different specified speeds. A portion of the chart showing the pressure is only an approximation because the ammeter is rather difficult to read since it oscillates with each stroke of the pump. Consequently, average values must be applied to determine approximate pump measures.

Table 2 shows the ammeter values of the transmission ratio in the drawworks for optimum hoisting results. The operator is able to observe the ammeter while registering current on a motor with a single assigned generator to obtain maximum performance. If the maximum value of the amps is exceeded after the load has reached its speed, a lower ratio should be shifted into so as to permit faster hoisting capabilities. If fewer amps than the minimum value under motor No. 2 are used, a higher ratio should be shifted into far faster hoisting speed. A good time to read the meter would be after the first full joint clears the rotary bushings.

Staying in the rotary high transmission ratio is recommended so long as the ammeter does not exceed 750 amps. By observing this practice, twist-offs will be minimized due to an excessive torque if the load should stall. The maximum available torque at the rotary table in the high mechanical ratio is 25,000 pounds, which is considerably less than 80 percent of the torsional yield strength of 4½-inch grade E drill pipe. The same practice could be observed to avoid parting while pulling tubing or light drill pipe.

Table 3 shows the approximate value of the rotary speeds and torque which is determined by observing the volt and amp meters on the drilling operators panel.

TABLE 3

DRUM	Transmission	MOTOR 1 Maximum	MOTOR 1 Minimum	MOTOR 2 Maximum	MOTOR 2 Minimum
Lo	Lo	2200	970	1100	520
Lo	Hi	2000	630	870	340
Hi	Lo	2000	820	910	460
Hi	Hi	2000	....	940	....

Motor 1 has two generators assigned to it.
Motor 2 has one generator assigned to it.

How good a driller are you?

A quiz for oil field folks. Score as follows: 0-4 (Weevil); 4-8 (Mud Doctor); 8-10 (Expert). One point for each correct answer.

1. **In general what effect will increasing the pump output have on the drilling rate?**
   (a) increase (b) no effect (c) decrease.
2. **A lime base mud is classified as a:**
   (a) low pH mud (b) a medium pH mud (c) a high pH mud.
3. **A phosphate type thinner is sometimes called a high temperature mud thinner. True or false.**
4. **An inhibited type mud is sometimes recommended for drilling swelling type shale because:**
   (a) shales will swell less (b) inhibited muds, have zero API filtrates (c) inhibited muds have high gel strengths.
5. **Match the following products with their specific gravities:**

(a) clay	**1.....4.3**
(b) water	**2.....0.8**
(c) diesel oil	**3.....6.8**
(d) galena	**4.....1.0**
(e) barite	**5.....2.5**

ANSWERS

1. a; 2. c; 3. False; 4. a; 5. 1-e; 2-c; 3-d; 4-b; 5-a.

Rig floor accidents CAN be prevented

Pipe handling equipment is the cause of most accidents

By J. Quinton
Cascade Drilling Company
Calgary, Alberta, Canada

TONGS, SLIPS, elevators, spinning chain and catheads cause more rig floor accidents than any other pieces of equipment. Last year, 838 accidents involving this equipment were reported as follows: tongs, 382; slips, 68; elevators, 213; spinning chain, 97; cathead, 78. Five were fatal, three involving tongs and two involving catheads.

A great percentage of accidents were caused by inexperience, lack of training, carelessness and poor supervision. Many accidents involving this equipment can be avoided by knowing the hazards to be encountered, by proper maintenance and by proper work practices and installations.

Tongs. To avoid tong accidents the following precautions are recommended:

- Safety lines should always be stronger than the jerk line. The safety lines should be attached to the derrick so that they are pulling in a horizontal plane in relation to the tong axis.
- Latch lugs should be checked for wear at the tips to prevent latch coming off on a hard pull.
- Bores of tong jaws should be checked for wear, especially the heads adjacent to the latch. Extreme wear at these points can cause the jaws to buckle and unlatch.
- Sharp tong dies should be used at all times.
- Tong latch springs should be checked for fatigue and distortion.
- On hard pulls the depth of tong should be fully in tool joint. Otherwise, an uneven load is exerted to the hinge and failure will occur at considerably less load.
- Hinge pins should be kept tight at all times to prevent spreading, thus maintaining a minimum clearance between the male and female hinge. This clearance held to a minimum prevents the pin from bending and approaches a shear failure which makes a stronger design.
- When swinging the tong into the tool joint the short jaw should strike the tool joint first. With the left hand holding the lug and short jaw firmly against the tool joint the right hand should push against the lever, forcing the tong jaw and latch jaw to move forward with sufficient force to latch the tong.
- Do not gamble with make-shift field repairs or welding that weakens the heat-treated strength of the tongs.
- When using power tongs for running tubing, operator should know which way tongs are going to move against the safety lines before he touches the tong throttle.
- Always cut off power on power tongs before putting hands in to remove or change jaws.

The majority of tong accidents are caused not by a mechanical failure but by improperly operating the tongs.

The tong handholds should be used when making up or breaking out drill pipe. Also proper location of the tongs on the tool joints should be of utmost concern. Many accidents have been caused by the top set of tongs catching the bottom tool joint as the pipe is spun out and backlashing, striking one or more workmen at the same time.

Worn snub and jerk lines contribute to many accidents and frequent inspection should be made before making a trip. The jerk line when located in the wrong place on the tong handle has resulted in at least one fatal accident and probably contributed to several others.

Slips. Slips contribute their share to accidents and although a relatively simple piece of equipment, they are

still misused and abused. Worn slips may result in the slip handles setting so close to the rotary table a man's hand, foot or instep is crushed for lack of clearance. Slips with rigid handles should be checked frequently for the proper clearance between the rotary table and handle.

Feet injuries frequently occur while working the back-up position. The position of the feet are occasionally placed too close to the slip handles and as the stand is spun out the slip handle strikes a man's foot with considerable force.

A driller may rapidly drop the elevators with a heavy hook load and since proper control is not maintained the elevators strike the slips either injuring a man's hands or knocking the slips over against his foot or leg, causing serious injury.

Accidents have occurred when handling the dog collar. As the pipe slides through the slips, the dog collar catches the man's hand and crushes it between the slips and the collar.

Slip dies should be kept in good condition. Occasional inspection of the hinges and handles is necessary, making sure the slips are well doped before being used. A set of slips in good shape, properly doped, can be easily set by one man, leaving the other floorhands free to handle the tongs. However, a poor set of slips with no dope have resulted in many a back injury.

Elevators. Elevators have contributed greatly to accidents around the rotary table and one of the major reasons is lack of teamwork between the driller and the men on the floor.

Improperly latched or defective elevators can release a tool joint, swinging away from the pipe and striking the man pulling the slips. This may result in a serious injury and a costly drill pipe fishing job. There are several reasons for an accident of this kind.

If the blocks are swinging at the instant the latcher tries to snap the elevators around the pipe, the elevator rim may be pulled so tightly against the tool joint box that the man may not be able to close and latch the elevators. Then the stress of picking up the pipe will cause the elevators to swing away from the pipe.

Cooperation and co-ordination is a must between the driller and his crew. The driller must allow ample time for latching the elevators and the pulling of the slips. He must remember that speed is not always the answer for efficient operations. The floor man latching the elevators should never remove his hands from the elevator horns as long as they fail to latch completely.

Very often a driller will drop the blocks rapidly striking the tool joint before the floorhand can swing them clear. The elevators then swing back against the links, pinning the man's hand between the elevator horn and the link. Very often this results in floorman catching his hand between the tool joint and the elevator and can be a serious accident. Numerous accidents have been caused to hands when they place them in the eyes of the links as they attempt to swing the elevators clear of the tool joint. A short piece of soft line attached to the eye of each link is an effective method of keeping the hands clear and avoiding many of these accidents.

The derrickman very often runs into difficulty on short stands. The driller drops the elevators so quickly he has no chance to unlatch them and as he pulls the stand back the elevator horns may catch his foot between the pipe and the monkey board. Worn latches, latch springs, hinge pins, elevator linkstraps, and bolts should be frequently inspected.

Spinning chain. Spinning chain is a good helper but can also be a dangerous enemy in the hands of an inexperienced or careless man. The amount of wraps that are used depends on the weather and pipe condition. Naturally, with the pipe being cold and the pipe dope stiff, more wraps may be required than in warm weather. The chain should be long enough so that the pipe is shouldered up before the end of the chain starts around the pipe. A short piece of soft line braided on the end of the spinning chain is a good safety factor in case the chain gets away from the floorman.

The man flipping the chain should always lead with his left hand. Tailing the chain into the pipe with the right hand has resulted in many broken arms because his hand became entangled in the wraps and was pulled around the pipe.

Once the chain is in motion the chain flipper should never put his hands on the wraps until the driller stops the catheads.

Again teamwork between the man spinning in the pipe and the driller is of great importance. An alert driller can very often prevent an accident if he acts quickly.

A spinning chain should be inspected frequently for wear; also the swivel and snap up lines. Automatic catheads should be kept in good condition and receive periodic maintenance checks.

Cathead. Probably one of the most useful but dangerous pieces of equipment on a drilling rig is the cathead. One of the most important precautions is to have a man at the controls while the cathead is being operated. Many men have been injured because there was no one to stop the cathead in time to prevent an accident occurring.

The proper size of catline should be used. Lines one inch and smaller are classed as hand lines and should never be used for a catline.

Always put the first wrap behind the rope divider to prevent the rope from fouling. The proper clearance between the cathead spool and the divider should be 3/8 of an inch. If the rope becomes fouled, the cathead should be stopped and the rope backed off until it can be untangled.

Cathead spools should not be allowed to become deeply grooved and should be wiped clear of grease and oil to prevent rope slippage and the dispersement of foreign particles in the operator's eyes.

The catline should never be allowed to fall in coils around the cathead man's feet as he brings in the line. This should be practiced because as it is let out again his feet may become entangled in the wraps pulling him over the cathead. The slack and kinks should be removed before a wrap is placed on the spool.

Before a man is allowed to operate the cathead he should receive proper instructions and some one should stay with him until it is plain he fully understands the safe, proper operation of the cathead.

ACKNOWLEDGMENT

This paper presented before the Canadian Association of Oil Well Drilling Contractors Safety Clinic, Calgary, Alberta, Canada, May 1-2, 1958.

How bankers evaluate oil-producing properties

By Lyon F. Terry and Kenneth E. Hill
The Chase Manhattan Bank, New York City

THERE ARE SEVERAL methods of valuing producing properties and numerous concepts of value, and they all have their purpose. From the standpoint of the lender on oil properties, the primary objective is to judge what might be realized from the sale of the property if it should become necessary to foreclose. For this purpose, the most significant concept of value is the "fair market value"—the price at which the property would be sold by a willing seller to a willing buyer, neither being under any compulsion to buy or sell, and both being competent and having reasonable knowledge of the facts.[1]

The method of valuation generally used by the institution with which the writers are associated is the estimation of the present worth of future profits at that discount rate which it is believed will result in the fair market value. This is often termed the engineering or analytic appraisal method and for several reasons is found most useful in valuing properties submitted as collateral for loan purposes. Most important is to ascertain by our own appraisal that the amount of the loan outstanding at any time could be recovered, if necessary, by foreclosure and sale.

Another important factor in judging the soundness of a loan is the ability of the property to generate sufficient net cash income, after all necessary operating, development, and income tax requirements, to amortize the loan within a reasonable time. This is ascertained from a payout schedule which is readily derived by a cut-and-try process from the forecast of net profits used in calculating the value, as shown in Tables 3 and 4. In addition, when the purchase of a property is partially financed by a loan, the lender and the buyer are in effect acquiring the property jointly. Prudent lenders will avoid participating in a project where the expenses may become so high that the operator might be unable to meet his obligations. And good bankers should avoid being a party to a transaction at a price so high that the customer later finds he has made an unprofitable purchase.

In this article the method of valuation generally used is described and illustrated by example in Tables 1, 3 and 4, which show the valuation and payout of a loan on the same property under different methods of purchase. The hypothetical property chosen for the examples is based on a typical dissolved gas-drive reservoir in Texas, as described by Muskat.[2]

While this article discusses valuation and loans for the purchase of a producing property, the methods used are equally applicable to all types of loans on oil and gas properties, whether waterflood, gasoline plant, or well-by-well development loans.

. . . purchased for cash

In valuing a property purchased for cash, as shown in Table 1, the future production, the gross revenue, and the costs of doing business are estimated year by year and the resulting annual net cash revenues are discounted, in this case at 8 percent, compounded annually, to arrive at the total present worth of future net receipts, here considered to approximate the value of the property. The value arrived at, $3.9 million, is equivalent to 91 cents per net barrel of oil in the ground.

There is nothing sacred about the 8 percent factor used in this case as the rate of discount, but it appears to the writers to result in a reason-

TABLE 1

Valuation and Payout of Property "P" Purchased for Cash

	Actual	Estimated Future								
	1957	1958	1959	1960	1961	1962	Total 5 Years	Thereafter	Grand Total	$ per Net Bbl.
NUMBER OF PRODUCING WELLS	30	33	36	37	37	37	.....	31	.....	.....
NET PRODUCTION:										
Crude Oil—Thous. Bbls.	384	434	460	461	431	396	2,182	2,118	4,300	.....
Natural Gas—Mill. Cu. Ft.	307	347	414	461	631	780	2,633	10,634	13,267	.....
	Thousand Dollars									
GROSS REVENUE:										
Oil @ $2.6 per Barrel[a]	1,021	1,154	1,224	1,226	1,146	1,053	5,803	5,634	11,437	.....
Natural Gas @ 7.5¢ per Mcf	23	26	31	35	47	59	198	798	996	.....
TOTAL	1,044	1,180	1,255	1,261	1,193	1,112	6,001	6,432	12,433	2.89
DEDUCTIONS:										
Operating Expenses	75	82	89	93	95	100	459	1,176	1,635	0.38
Prod. and Ad Valorem Taxes	62	70	76	76	70	67	359	382	741	0.17
Gen. and Admin. Expenses	22	24	26	28	30	30	138	300	438	0.10
Intangible Dev. Expend.	300	150	150	50	60	.....	410	125	535	0.13
Depletion & Depreciation[b]	297	395	419	419	392	360	1,985	1,927	3,912	0.91
TOTAL	756	721	760	666	647	557	3,351	3,910	7,261	1.69
TAXABLE INCOME	288	459	495	595	546	555	2,650	2,522	5,172	1.20
Federal Income Tax @ 52%	150	239	257	309	284	289	1,378	1,311	2,689	0.62
NET INCOME	138	220	238	286	262	266	1,272	1,211	2,483	0.57
Add back: Depl. & Depr.	297	395	419	419	392	360	1,985	1,927	3,912	0.91
SUB-TOTAL	435	615	657	705	654	626	3,257	3,138	6,395	1.48
Less: Tangible Dev. Expend.	180	90	90	30	.....	.....	210	150	360	0.08
NET CASH INCOME	255	525	567	675	654	626	3,047	2,988	6,035	1.04
Discount Factor at 8%	.....	.93	.86	.79	.74	.68	.79	.49	.65	.65
PRESENT WORTH	.....	488	488	533	484	426	2,419	1,483	3,902	0.91

Notes: [a] $2.55 for 35° oil plus $0.11 for Nat. Gas Liquids.
[b] 1952 Statutory, thereafter at Cost ($0.91 per Bbl.)

able estimate of the fair market value for this type of property as indicated by sales of similar properties.

If the rate of discount is too low, the resulting answer will be too high and vice versa. For properties that are fully developed, long-lived, and whose reservoir conditions are well known, estimates of reserves and operating conditions can be made with considerable certainty so that the discount factor should be correspondingly low. And conversely where the opposite is true, the factor should be relatively high.

The discount factor used should be that rate of return or yield on the purchase price which is sufficient to induce a producer to risk his funds in the particular project evaluated rather than in safer investments offering lower yield. The rate must be commensurate with the physical hazards of producing and the economic uncertainties of future production, prices, expenses, and production control. In principle, it is the same incentive as that recognized in the regulation of public utilites where the reasonable rate of return upon the fair value of the property (the rate base) is held to be that sufficient to induce the investment of capital in establishing, maintaining, and expanding the property.

The Federal Power Commission, for exemple, has been allowing a 6 percent rate of return to natural gas pipe line companies. Assuming adequate demand for the transmission service rendered which these pipe line systems generally enjoy, the companies are practically assured of earnings equal to the rate of return allowed. These enterprises are highly rated by investors and by comparison the employment of funds in producing oil and gas properties should generally deserve a rate of return higher than that obtainable in such public utilities investments.

The value sought should be the fair market value of the property as previously described, and if the proper rate of discount is chosen, the answer should approximate this value. Whatever process of valuation is used, the objective is to find what the property would sell for; that is, its fair market value. If the property be purchased at the value found by the engineering appraisal method, the purchase price will be recouped out of net cash proceeds together with a profit on the diminishing balance of the investment, at the same rate of return as the discount rate used in the valuation. This is proved in Table 2.

It should be pointed out that provision for estimated income taxes is made in the calculation before discounting estimated future cash income to present worth. The taxes here assumed are computed at the 52 percent rate for corporations after allowance for intangible devlopment expense and depletion on cost, which in this case is higher than statutory depletion. **Income taxes comprise one of the costs of doing business and must be provided for out of the producing operation.**

The producing properties which often get into difficulties are those whose owners had failed to provide for future income taxes. An oil producer may be so fortunate in successful drilling at an increasing rate that his intangible drilling deductions will preclude income taxes for a number of years. But if such an operator eventually runs out of drilling locations or funds for further development, he may be forced to sell property to meet his taxes or loan obligations.

. . . purchased by direct loan

In Table 3 is shown an estimate of the future cash flow from the same property, assuming it to be purchased at the same price, $3.9 million, comprised of $1.4 million in cash and $2.5 million obtained by loan. The earnings of the property will be the same as in Table 1 where it was assumed to be purchased for cash. The income taxes of the operator of the property will be slightly less than in Table 1, but the lender will be taxed

TABLE 2
Return of Investment With 8% Profit

Year	Net Cash Income	ALLOCATION OF NET CASH INCOME TO: Earnings at 8%	Return of Capital	Investment Remaining at Beginning of Year
	Thousand Dollars			
1958	525	312	213	3,902
1959	567	295	272	3,689
1960	675	273	402	3,417
1961	654	241	413	3,015
1962	626	208	418	2,602
1st 5 Yrs.	3,047	1,329	1,718	.....
1963	570	175	395	2,184
1964	450	143	307	1,789
1965	385	119	266	1,482
1966	368	97	271	1,216
1967	294	76	218	945
1968	239	58	181	727
1969	181	44	137	546
1970	133	33	100	409
1971	95	24	74	309
1972	104[a]	18	86	235
1973	79	11	68	149
1974	57	5	52	81
1975	30	1	29	29
TOTAL	6,035	2,133	3,902	.....

[a] No expenditures for pumping equipment required after 1966.

TABLE 3
Valuation and Payout of Property "P" Financed by Direct Loan

Estimated Future	1958	1959	1960	1961	1962	Total 5 Years	Thereafter	Grand Total	$ per Net Bbl
NET PRODUCTION:									
Crude Oil—Thous. Bbls.	434	460	461	431	396	2,182	2,118	4,300	.....
Natural Gas—Mill Cu. Ft.	347	414	461	631	780	2,633	10,634	13,267	.....
	Thousand Dollars								
GROSS REVENUE[a]	1,180	1,255	1,261	1,193	1,112	6,001	6,432	12,433	2.89
DEDUCTIONS:									
Operating Expenses	82	89	93	95	100	459	1,176	1,635	0.38
Prod. and Ad Valorem Taxes	70	76	76	70	67	359	382	741	0.17
Gen. and Admin. Expenses	24	26	28	30	30	138	300	438	0.10
Intangible Dev. Expenditures	150	150	50	60	.....	410	125	535	0.13
Depletion and Depreciation[b]	395	419	419	392	360	1,985	1,927	3,912	0.91
Interest @ 4½% P.A.	104	84	63	39	14	304	.....	304	0.07
TOTAL	825	844	729	686	571	3,655	3,910	7,565	1.76
TAXABLE INCOME	355	411	532	507	541	2,346	2,522	4,868	1.13
Federal Income Tax @ 52%	185	214	277	264	281	1,221	1,311	2,532	0.59
NET INCOME	170	197	255	243	260	1,125	1,211	2,336	0.54
Add back: Depl. and Depr.	395	419	419	392	360	1,985	1,927	3,912	0.91
SUB-TOTAL	565	616	674	635	620	3,110	3,138	6,248	1.45
Less: Tangible Dev. Expend.	90	90	30	.....	.....	210	150	360	0.08
NET CASH INCOME	475	526	644	635	620	2,900	2,988	5,888	1.37
Excess over Loan Requirements	75	76	144	85	20	400	2,988	3,388	0.79
Discount Factor at 11½%	.90	.80	.72	.65	.58	.75	.37	.41	.41
PRESENT WORTH	68	61	104	55	12	300	1,106	1,406	0.33
LOAN AMORTIZATION SCHEDULE:									
Loan at Beginning of Year	2,500	2,100	1,650	1,150	600	.....	.....	.....	.....
Less: Principal Payments	400	450	500	550	600	2,500	.....	2,500	0.58
Loan Balance at End of Year	2,100	1,650	1,150	600	—0—	TOTAL VALUE		3,906	0.91

Notes: [a] Crude Oil incl. Nat. Gas Liquids @ $2.66 per Bbl. Natural Gas @ 7.5¢ per Mcf.
[b] At Cost ($0.91 per Bbl.)

on the interest recived from the operator, so that the sum of the income taxes arising from the operation of the property will be approximately the same. From a practical standpoint the ownership of the property so financed may be considered as a combined undertaking by the purchaser and the lender since both obtain the return of their capital and profits thereon solely out of the operation of the property. The net cash return from the property is the same as if it were purchased for cash, as in Table 1. The 8 percent return on the property is shown in Table 3 to be equivalent to 4½ percent to the lender and 11½ percent on the equity funds of the operator.

Comparison of Tables 1 and 3 will show the fallacy of attempting to value property by using a rate of discount equal to the rate of interest that can be obtained on mortgage money. The lender incurs but little risk since his investment is to be repaid first and he may be willing, therefore, to loan at 4 or 5 percent. But the purchaser, who puts up the balance of the cost of a property, takes practically all the risk and, as shown in Table 3, should be entitled to the 10 or 12 percent rate of return on his part of the undertaking.

. . . purchased by oil payment

An oil payment is a property right to a specified portion of the reserves and production of a property until the proceeds thereof, free and clear of expenses, shall amount to a stipulated sum, plus interest thereon at a stated rate. The residual interest owner is obligated to operate and develop the property without cost to the oil payment owner.

The use of an oil payment in the purchase of a property is illustrated in Table 4, where it is assumed that the same property as shown in Tables 1 and 3 is purchased for $1.2 million cash subject to an oil payment of $3.5 million, plus interest at 5½ percent, payable out of 70 percent of the production. The oil payment is sold simultaneously to a third party, who borrows the entire cost of his investment, at 4½ percent, and retains the one percent difference as interst on which he pays income taxes. He pays no taxes on the balance of his receipts which are construed to be the return of his capital investment on which he is allowed cost depletion. The operator of the property retains 30 percent of the production out of which he pays his operating and development costs and income taxes.

The oil payment is generally designed so that the operator's net income will be quite small and his resulting taxes insignificant until the oil payment has been paid off, when the operator will come into full possession of all the production. Thus, the combined income taxes of all the parties, including the operator, the owner of the oil payment, and the lender, are much reduced until the oil payment has been liquidated. Hence, if the property be purchased by this procedure, it will be worth more than if purchased for cash or financed by a direct loan.

In the examples shown, the total taxes to all parties (including taxes on interest) amount to $2,689,000 in Tables 1 and 3 and to $1,660,000 in Table 4, showing a tax savings of $1,029,000. The present worth of this savings at 2 percent is $800,000. Adding this increment to the value of $3.9 million found in Table 1 indicates a value of $4.7 million for the same property if purchased by the oil payment procedure, or 20 percent more than if the property were purchased for cash or by direct loan.

It can be shown by mathematics similar to that used in Table 2 that the purchase price of $4.7 million will be returned, plus a yield of 8 percent on the diminishing balance. And as shown in Table 4, the 8 percent average combined return from the property is equivalent to 4½ percent to the lender, 1 percent to the owner of the oil payment, and 12¾ percent to the operator. The operator has his income long deferred, takes most of the risk and, as in the case of property bought by direct loan, is entitled to a relatively high rate of return.

TABLE 4
Valuation and Payout of Property "P" Purchased by Use of Oil Payment

Estimated Future	1958	1959	1960	1961	1962	Total 5 Years	Thereafter	Grand Tota	$ per Net Bbl.
NET PRODUCTION									
Crude Oil— Thous. Bbls.	434	460	461	431	396	2,182	2,118	4,300	.....
Operator's Share " "	130	138	138	129	132	667	2,118	2,785	.....
Natural Gas— Mill. Cu. Ft.	347	414	461	631	780	2,633	10,634	13,267	.....
					Thousand Dollars				
GROSS REVENUE[a]	1,180	1,255	1,261	1,193	1,112	6,001	6,432	12,433	2.89
30% to Operator until Oil Payment Liquidated	354	376	378	358	370	1,836	6,432	8,268	2.97
DEDUCTIONS OF OPERATOR:									
Operating Expenses	82	89	93	95	100	459	1,176	1,635	0.59
Prod. and Ad Valorem Taxes	36	40	40	36	33	185	382	567	0.20
Gen. and Admin. Expenses	24	26	28	30	30	138	300	438	0.16
Intangible Dev. Expenses	150	150	50	60	.....	410	125	535	0.19
Depletion and Depreciation[b]	56	59	84	69	104	372	2,015	2,387	0.86
TOTAL	348	364	295	290	267	1,564	3,998	5,562	2.00
TAXABLE INCOME	6	12	83	68	103	272	2,434	2,706	0.97
Federal Income Tax @ 52%	3	6	43	35	54	141	1,266	1,407	0.51
NET INCOME	3	6	40	33	49	131	1,168	1,299	0.46
Add back: Depl. and Depr.	56	59	84	69	104	372	2,015	2,387	0.86
SUB-TOTAL	59	65	124	102	153	503	3,183	3,686	1.32
Less: Tangible Dev. Expend.	90	90	30	.....	.....	210	150	360	0.13
NET CASH INCOME	—31	—25	94	102	153	293	3,033	3,326	1.19
Discount Factor at 12¾%	.89	.79	70	.62	.55	.56	.34	.36	.....
PRESENT WORTH	—28	—20	66	63	84	165	1,035	1,200	0.28
OIL PAYMENT SCHEDULE:									
70% of Gross Income	826	879	883	835	742			4,165	.....
Less: 70% of Production Tax	34	36	36	34	34			174	.....
Interest @ 5½% P. A.	176	139	99	58	19			491	.....
NET AVAIL. FOR OIL PAY. REDUCTION	616	704	748	743	689			3,500	0.81
LOAN AMORTIZATION SCHEDULE:									
Loan Outstanding at Beg. of Year	3,500	2,884	2,180	1,432	689				
Less: Principal Payment	616	704	748	743	689				
Loan Balance at End of Year	2,884	2,180	1,432	689	—0—	TOTAL VALUE		4,700	1.09

Notes: [a] Crude Oil incl. Nat. Gas Liquids @ $2.66 per Bbl.; Natural Gas @ 7.5¢ per Mcf.
[b] 1953-4 at Cost (43¢ per Bbl.), thereafter Statutory.

. . . turn the page for a comparison of these three financing methods

. . . comparing the three financing methods

The foregoing treatment of the valuation and payout of the same property under the same assumption of 8 percent return, but for different methods of financing, as detailed in Tables 1, 3 and 4, is summarized in Table 5.

Ratio of Loan to Value. From the standpoint of the lender, it is important to have an ample factor of safety between the amount to be loaned and the estimated value of the security. No estimate of reserves nor forecast of future earnings can be perfect. There is always the uncertainty of estimating future production, the possibility of fluctuation in the price of oil, and the hazard that the actual costs of operations and future development may overrun the best of estimates.

In financing this property by a direct loan, the ratio of the loan to the estimated value of the property (the loan ratio) in the example shown is 64 percent. A loan ratio of 60 to 70 percent is ordinarily good practice and a reasonable percentage of the value of the property, depending upon other factors that should be considered.

Another test of the safety of a loan is that the esitmate of total future production from the property should be at least twice as great as the production required to pay off the loan. In fact, if this last qualification is met, the loan ratio will be within 60 to 70 percent of the value because the present worth of net cash income from the first half of the future production generally approximates this percentage of the total value.

In oil payment financing, the loan ratio is usually higher than for direct loans. The higher the ratio of the oil payment to the value of the property, the greater will be the savings in taxes, all of which savings being available for the repayment of the loan. The savings in taxes increase the total net return from the property, and hence the value of the property.

It should be pointed out, however, that the proportion of production allowed the oil payment owner (70 percent in the example shown in Table 4) should be so limited that the remaining production retained by the operator (30 percent in this case) will be sufficient to provide the latter with ample funds to continue the operation and development of the property. As production declines, the proceeds retained by the operator may approach the cost of operation. During the term of the oil payment, the operator's profit will be quite small and his real inducement is to pay off the oil payment so that he will become entitled to the entire production from the property.

The owner of the oil payment must look to the operator to continue operations until the oil payment has been satisfied. The bank financing the oil payment must also depend upon the operator continuing operations, although the bank deals only with the owner of the oil payment and has no recourse to the operator. Hence, from the standpoint of the lender, it is wise and reasonable to require that:

1. The operator, being the owner of the residual, covenant with the oil payment owner to continue operations until the oil payment shall have been paid off.
2. The owner of the oil payment, that is, the borrower from the bank, have assets of consequence in addition to the oil payment, to which the bank may have recourse.

The lender will require that the operator of the property should be capable and reliable, whether a loan be made direct on the property or by the oil payment procedure. But because the loan ratio in the case of an oil payment may be higher than by direct loan, it is good business from the standpoint of the lender on the oil payment to require the above two qualifications and any other conditions which under the particular circumstances of the oil payment loan will assure its safety.

TABLE 5

Comparison of Valuation of a Property Under Various Methods of Financing

Refer to Table		Appraised Value	Discount Rate or Rate of Return	Value Per Barrel	Loan Ratio
		Thousand Dollars	%	$/Net Barrel	%
1	Purchase for Cash.....	3,900	8	0.91	....
3	Purchase with Loan.....	2,500	4½	....	64
	Cash.....	1,400	11½	....	....
	TOTAL.....	3,900	8	0.91	....
4	Purchase by Oil Payment.	3,500	5½	....	74
	Cash.....	1,200	12¾	....	....
	TOTAL.....	4,700	8	1.09	....
Determination of value by oil payment method: Value by Tables 1 or 3 above.....		3,900	8		
Present Worth of Tax Savings.....		800	8		
Value by oil payment method.....		4,700	8		

Conclusions. So far as the value of a property and the loan ratio thereon can be used as one of the criteria for judging the soundness of a loan, no hard and fast rule can be or should be set up. For properties that are exceedingly long-lived and whose reservoir conditions are such that great confidence can be placed in the estimate of reserves and operating costs, it is obvious that the loan ratio may be relatively high with equal safety. The same applies to natural gas producing properties with a 20-year take-or-pay sales contract. But where the production of the property is expected to decline rapidly or where the estimate of oil reserves cannot be relied upon with full confidence, the loan ratio should be lower. It all depends upon the particular property and circumstances.

The objective is to avoid unsafe loans. And the real test should not be whether the loan and the property can qualify under previously specified ratios—but: Is it a good loan under all the particular circumstances? That takes experience and judgment.

ACKNOWLEDGMENT

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In South Texas' Wilcox Trend Natural gas prospects are good

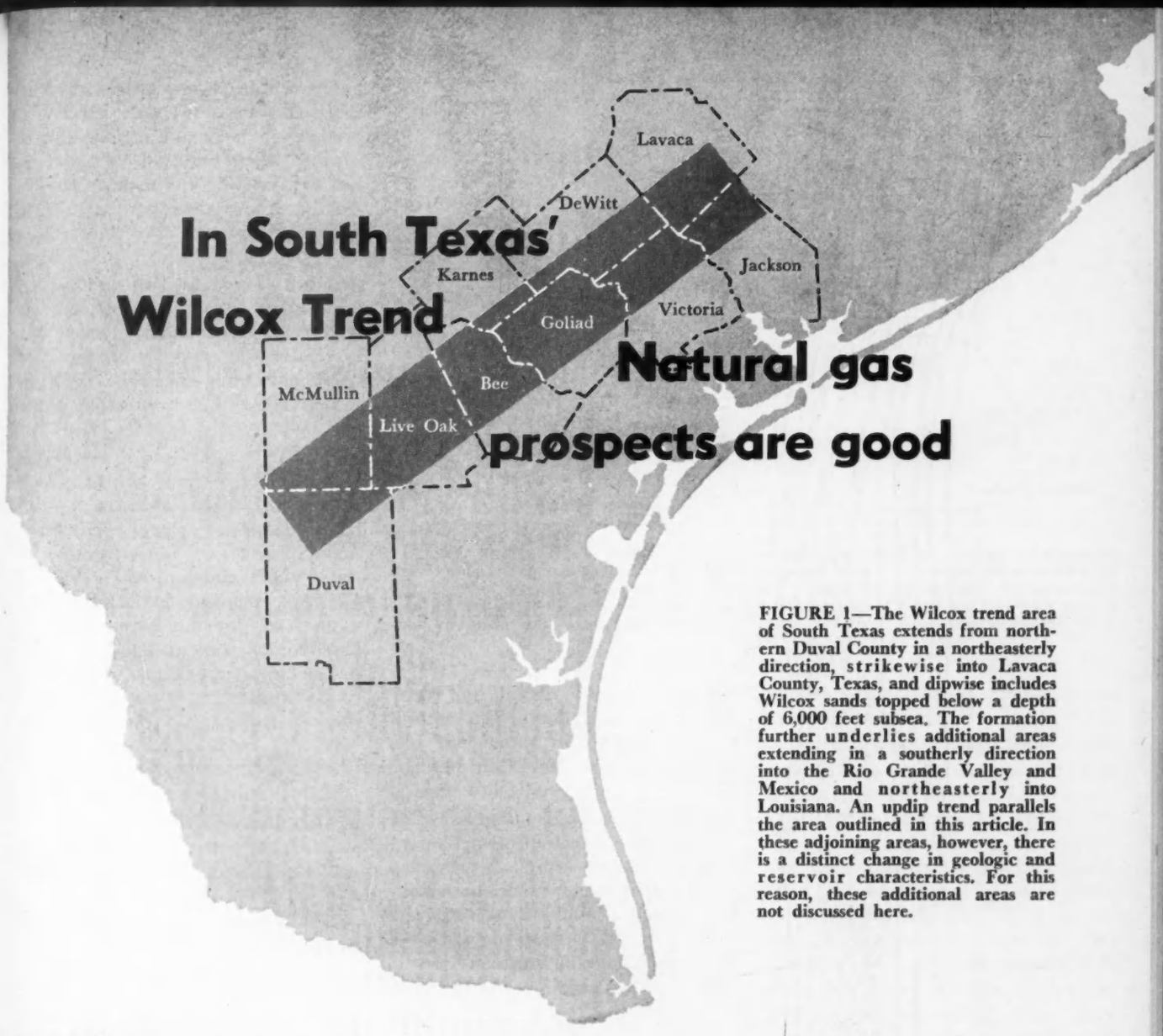

FIGURE 1—The Wilcox trend area of South Texas extends from northern Duval County in a northeasterly direction, strikewise into Lavaca County, Texas, and dipwise includes Wilcox sands topped below a depth of 6,000 feet subsea. The formation further underlies additional areas extending in a southerly direction into the Rio Grande Valley and Mexico and northeasterly into Louisiana. An updip trend parallels the area outlined in this article. In these adjoining areas, however, there is a distinct change in geologic and reservoir characteristics. For this reason, these additional areas are not discussed here.

By Fred L. Oliver
President, Fred L. Oliver Associates
Dallas

The ready market and the prices paid for gas and condensate make the Wilcox Trend of South Texas an interesting area for exploratory drilling.

Activity in the area indicates that there is still gas to be discovered and room for expansion of transmission lines for the next few years. Discovery rates and return on invested capital are sufficient to attract drilling and development programs during the foreseeable future.

The trend presents engineering and geologic problems. However, these problems can be solved with diligent effort by people with knowledge and experience in the area. Electric logs are valuable tools and are amenable to quantitative interpretation in Wilcox sands. Detailed reflection seismograph surveys can be expected to be representative of subsurface structures. Core and other test data also are reliable in indicating zones of interest and economic importance.

The Wilcox Trend includes 193 fields which produce from Wilcox reservoirs. It extends area-wise from northern Duval County to Lavaca County, Texas. Approximately 70 percent of the fields are gas and condensate productive, so the area is considered primarily a natural gas trend.

Reservoir characteristics of Wilcox sands create some definite engineering problems. Recognition and solution of these problems represents the difference between a sound operating program with a good return on invested capital and a marginal or sub-economic operation. This article points out the geologic and reservoir conditions that create these problems and indicates some drilling, development and completion procedures that will help minimize their effects in the future.

The economic importance of the trend has been minimized and the engineering and geological problems emphasized for many years. General reservoir characteristics of the sands have made oil wells expensive considering the amount of recoverable oil obtained. This has resulted in a comparatively small return on investment which is the primary reason for the

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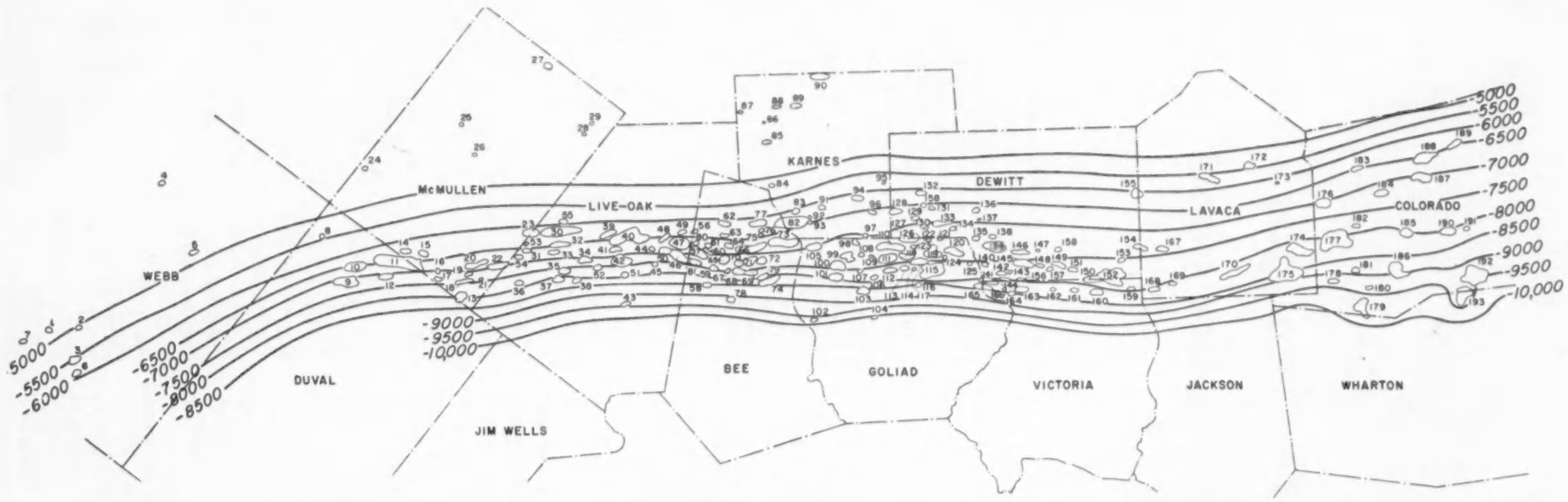


WEBB COUNTY

KEY	FIELD	TOP OF WILCOX
1.	RETAMIA	-4500
2.	REISER	-5100
3.	AGUILARES	-5550
4.	HIRSCH	-3600
5.	NICHOLSON	-4800
6.	SOUTH AGUILARES	
7.	S.W. RETAMIA	

DUVAL COUNTY

8.	CHARAMOUSCA	-5100
9.	NORTH GOVT. WELLS	-7200
10.	PIEDRE LUMBRE	-6500
11.	HAGIST RANCH	-6550
12.	SEVEN SISTERS	-7300

McMULLEN COUNTY

13.	HOSTETTER	-7900
14.	NORTH HAGIST RANCH	-6150
15.	LOMA ALTA	-6300
16.	ROOS	-6950
17.	CAMPANA	-7400
18.	NORTH HOSTETTER	-7300
19.	JAKE HAMON	-7000
20.	RHODE RANCH	-6900
21.	BRAZIL	-7700
22.	BAKER	-7000
23.	SAN CAJA	-6100
24.	LITTLE ALAMO	-3700
25.	DILWORTH	-3750
26.	LOWE RANCH	-4250
27.	SAN MIGUEL CREEK	-2800
28.	OPOSSUM	-3750
29.	JAMBERS	-3500

LIVE OAK COUNTY

30.	CLAYTON	-6100
31.	TEXAM	-6550
32.	MAXINE-CLAYTON	-6450
33.	MAXINE	-6700
34.	WEST GEORGE WEST	-7000
35.	TOM LYNE	-7550
36.	CHAPA RANCH	-7750
37.	CLAY WEST	-8800
38.	KITTY WEST BURNS	-8750
39.	KITTY WEST	-6400
40.	OAKVILLE AREA	-6550
41.	SUNSET	-6950
42.	HARRIS	-7200
43.	MIKESKA	-9650
44.	MARSDEN	-7100
45.	DUNN	-7700
46.	SOUTH KARON AREA	-7300
47.	KARON	-6700
48.	GOEBEL	-6300
49.	NORTH GOEBEL	-6300
50.	COQUAT	-7300
51.	(WILDCAT)	-8300
52.	BRASLAU	-7400
53.	HOUSE	-6500
54.	SOUTH TEXAM	-6550
55.	(WILDCAT)	-6150

BEE COUNTY

56.	RUDMAN	-6250
57.	MINOAK AREA	-6850
58.	THEIS	-8500
59.	HOLZMARK	-7400
60.	YOWARD	-7000
61.	GOREE	-6600
62.	PLUMMER	-6100
63.	CANNON	-6300
64.	WEST MINERAL	-6700
65.	MINERAL	-7050
66.	NORTH MINERAL AND WEST COSDEN	-6700
67.	VOSS	-7400
68.	SAN DOMINGO	-7350
69.	STRAUGH	-7650
70.	RAY	-7200
71.	WEST TULETA	-7150
72.	TULETA	-7200
73.	TULSITA	-6600
74.	NORMANNA	-8400
75.	CROFT	-6450
76.	DAHL	-6250
77.	SOUTH CAESAR	-6000
78.	PEARL COLLIER	-9100
79.	SOUTH TULETA	-7900
80.	S.W. YOWARD	-7000
81.	RAGSDALE	-7300

KARNES COUNTY

82.	BURNELL	-6200
83.	GREEN	-6100
84.	JOHNSON	-5200
85.	COY CITY	-4350
86.	DZUIK	-3600
87.	EAST FASHING	-3550
88.	HYSAW	-3500
89.	HOBSON	-3600
90.	FALLS CITY	-2550
91.	HONDO CREEK	-6050
92.	BELKNAP	-6300
93.	CHOATE	-6550
94.	RUNGE AREA	-6300
95.	EAST RUNGE	-5750
96.	PARGMANN	-6700
97.	McCASKILL	-7000

GOLIAD COUNTY

98.	NORTH CHARCO	-7300
99.	RIVER, GLADYS POWELL	-7200
100.	HORDES CREEK	-7300
101.	DIAL	-7950
102.	BELCLAIR	-9650
103.	RIVERDALE	-8600
104.	WEST GOLIAD	-10,600
105.	DIAMOND	-6000
106.	ALBRECHT	-7850
107.	ANGEL CITY	-7800
108.	CHARCO	-7350
109.	YANTA	-7250
110.	BOYCE	-7000
111.	CABEZA CREEK	-7300
112.	SOUTH CABEZA CREEK	-7750
113.	POEHLER	-7800
114.	EAST POEHLER	-7900
115.	SOUTH WEESATCHE	-7700
116.	MARSHALL	-8600
117.	WEST WEESATCHE	-7700
118.	MELROSE	-7400
119.	GOTTSCHALT	-7300
120.	BRANDT	-7100
121.	HEINZEVILLE	-7250
122.	EMMA HAYNES	-7350
123.	MANAHUILLA	-7200
124.	BREEDEN	-7600
125.	(WILDCAT)	-7900

DEWITT COUNTY

126.	SLICK	-7050
127.	PENA	-7164
128.	NORDHEIM	-6700
129.	CHRISTMAS	-6950
130.	BAACHE	-7200
131.	WARMSLEY	-6500
132.	ROEDER	-6200
133.	HENZE	-7000
134.	WEST HOLLY	-7100
135.	HOLLY	-7200
136.	YORKTOWN	-6800
137.	SOUTH YORKTOWN	-6950
138.	COTTONWOOD CREEK	-7200
139.	SO. COTTONWOOD CREEK	-7250
140.	DOEHRMANN	-7900
141.	MEYERSVILLE	-8200
142.	NORTH MEYERSVILLE	-7800
143.	HYNES	-7950
144.	EAST MEYERSVILLE	-7900
145.	ARNECKEVILLE	-7700
146.	NORTH ARNECKEVILLE	-7350
147.	KOENIG	-7450
148.	ANNA BARRE	-7700
149.	THOMASTON	-7600
150.	WEST HELEN GOHLKE	-7900
151.	JENNY BELL	-7650
152.	HELEN GOHLKE	-7800
153.	BERRY-HEATON	-7500
154.	BRUSHY CREEK	-7400
155.	YOAKUM	-6100
156.	NORTH MISSION VALLEY	-8200
157.	(WILDCAT)	
158.	(WILDCAT)	

VICTORIA COUNTY

159.	EAST FORDTRAM	-7900
160.	S.W. HELEN GOHLKE	-8350
161.	ROB WELDER	-8300
162.	ADCOCK	-8200
163.	MISSION VALLEY	-8200
164.	DREYER	-8300
165.	W. MISSION VALLEY	-8450
166.	SOUTH MEYERSVILLE	-8200

LAVACA COUNTY

167.	HOPE	-7400
168.	CHICOLETE CREEK	-8000
169.	BORCHERS	-8050
170.	SOUTH SPEAKS	-8100
171.	WORD	-5600
172.	HALLETTSVILLE	-5300
173.	MARTISEK	-6100
174.	VIENNA	-8150
175.	PROVIDENT CITY	-8800

COLORADO COUNTY

176.	SUBLIME	-7000
177.	SHERIDAN	-8000
178.	GARWOOD	-9400
179.	NADA	-9500
180.	BUCK SNAG	-9400
181.	MUSTANG CREEK	-8600
182.	ROCK ISLAND	-7650
183.	HAMEL	-6500
184.	GLASSCOCK	-7200
185.	ALTAIR	-8000
186.	ENGLEHART	-8900
187.	CECIL NOBLE	-7000
188.	COLUMBUS	-6500
189.	FRELSBURG	-6400
190.	RAMSEY	-7800
191.	EAGLE LAKE	-8400
192.	CHESTERVILLE	-9500

WHARTON COUNTY

193.	LISSIE	-9250

FIGURE 2—Productive areas of fields producing from the Wilcox formation are outlined here. Structural contours have been drawn on the map to indicate the approximate subsea depth of this formation. Included in the area are more than 193 fields.

pessimistic attitude toward the drilling of Wilcox tests. There are exceptions to this general statement, for several oil fields in the area would be considered good in any oil trend. In this article, the Wilcox is considered primarily a natural gas and condensate trend.

The statistics contained in this article indicate that proper engineering and geologic techniques, accompanied by prudent operation of wells make the Wilcox Trend worthy of additional exploration and exploitation.

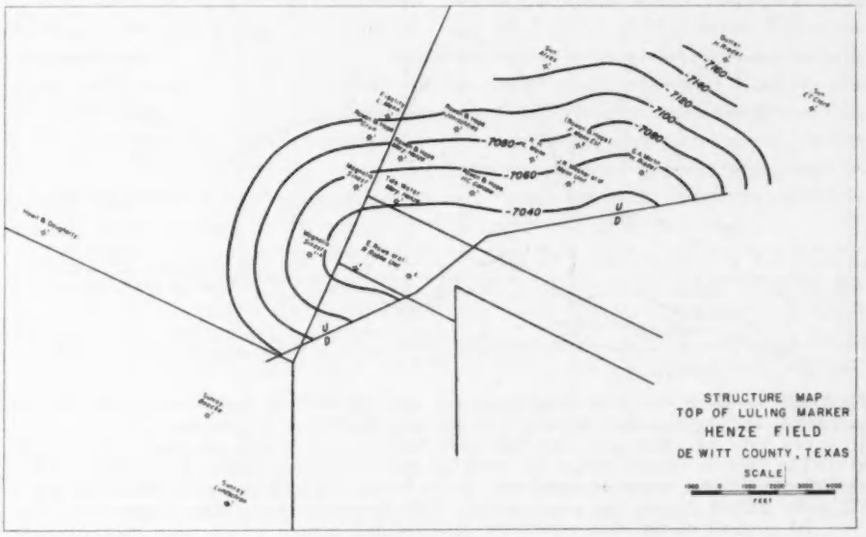


FIGURE 3—The Henze field in DeWitt County is an excellent example of excessive development. Ten gas wells and six dry holes were drilled to recover an estimated 25 billion cubic feet of gas from approximately 1,000 acres. In the author's opinion, a total of five wells could have accomplished the same result, if acreage had been pooled into gas units and more care and study taken in initial development of the field.

Geology. The Wilcox sands of Eocene age in South Texas consist of shallow marine and continental facies. They are generally described as coarse to fine grained, heterogeneous, cross-bedded sands interbedded with silts, clays, peat, and lignite. Deposition evidently took place on flood plains in nearshore marine water, lakes, swamps, embayments and a wide flat coastal plain traversed by shifting streams—aggrading, degrading and flooding in much the same depositional environment that prevails along the Gulf Coast today.

Wilcox sand development does not represent a time plane, in that the seas were retreating during early Wilcox deposition, fluctuating with a slow subsidence of the coastal plains during middle Wilcox and encroaching in the final period of Wilcox time. Sands toward the outcrop are of different age than the downdip beds; thus, regionally, sand members are not correlatable dipwise as time units. In localized areas and strikewise for considerable distances, sand and shale zones are generally distinctive, making electrical log correlation comparatively easy in most cases.

Structurally, Wilcox reservoirs in South Texas are characterized by low relief, elongated anticlines associated with normal down-to-the-coast faulting. Generally, structures which close against a fault are on the upthrown block. However, structures often seem to have been created simultaneously with the faulting and the formation dips into the fault on both the upthrown and downthrown blocks.

Toward the Rio Grande Valley there are generally fewer structures and less faulting. Also, sands tend to be tighter and have more predominantly marine facies. Drilling activity has been sparse and results generally discouraging. However, drilling in Webb and Zapata counties during the past several months has been active and the recent discoveries will encourage additional work in the Rio Grande Valley area.

Beginning in Lavaca County and extending northeasterly, the Wilcox has larger structures. Apparently these structures are less dependent on faulting. Lower members of the formation often are productive. Upper members of the Wilcox are more predominantly productive in the area shown in Figure 1.

The updip Wilcox lacks structural closure in many areas and faulting is not as prevalent. These features reduce chances for favorable traps for the accumulation of oil or gas and account for the sparsity of updip fields.

Reservoir characteristics. The mode of deposition of the sand members of the Wilcox formation caused a high degree of heterogeneity. Because of this, sand characteristics vary widely from well to well in the same reservoir, from field to field, and regionally. The resultant variable range of porosities and permeabilities presents the main barrier to adequate interpretation of reservoir characteristics and accurate predictions of reservoir performance.

Wilcox reservoirs average about 20 percent porosity and 76 millidarcys permeability. Connate water averages about 35 percent.

Normally, active water drive is not expected; however, water coning is a definite hazard. Often in Wilcox sands, vertical permeability is of the same magnitude as the horizontal. Gas coning also is a definite problem. It is not uncommon to have both water coning and gas coning at the same time when oil completions are attempted in the thin oil columns that often rim many of the reservoirs. Drilling with controlled muds, good primary cement jobs, perforation of short production intervals and restricted rates of production all help to alleviate the coning problem. However, nothing is as good as a strategically located shale break near the gas or water contact.

Water blocking is a major hazard. However, with carefully controlled muds and good completion practices such as spotting non-contaminating fluids opposite the interval to be perforated and the use of mud acids and fracturing where needed, water blocking can be avoided. It should be stressed that the Wilcox is very susceptible to water blocking. Preventive measures always should be taken in advance.

High connate water, low porosity and permeability, gas and water coning and depletion drive reservoir energy all tend to reduce the amount

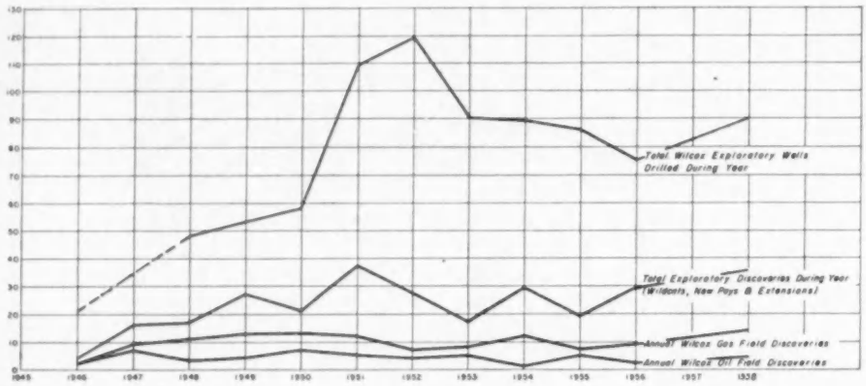

Total Wilcox Exploratory Wells Drilled During Year
Total Exploratory Discoveries During Year (Wildcats, New Pays & Extensions)
Annual Wilcox Gas Field Discoveries
Annual Wilcox Oil Field Discoveries

FIGURE 4—Here, the new field discovery rate for wildcat wells testing the Wilcox formation and exploratory drilling activity are illustrated graphically. The new field discovery rate has averaged one discovery for every 5.3 wildcats drilled from 1946 to 1957. This is almost twice as good as the national average. Exploratory wells, including wildcats, extensions and new pays, have averaged one completion for every 3.2 wells drilled during the same period. This discovery rate is very impressive; however, 70 percent of the discoveries are gas-condensate wells which until recently have required a longer payout period. Also, a certain percentage of the discoveries later prove to be non-commercial.

of recoverable oil that can be expected from any particular well or reservoir. In some larger reservoirs cycling operations, pressure maintenance, or secondary recovery programs are feasible. But the general solution is greater spacing of wells and reasonable production rates for the particular reservoir under consideration. Currently, oil well spacing in the Wilcox probably averages about 20 acres and gas wells average about 160 acres. The author considers these to be too small for the per acre recoveries that can be expected from the average Wilcox reservoir.

Exploration and development. When an exploration program is initiated, areas of interest usually can be isolated by quantitative interpretation of electric logs and subsurface studies, coupled with a review of all test and core data and knowledgeable experience. As Figure 2 would indicate, the number of wells in the Wilcox trend is generally sufficient to give good subsurface control in most localities. However, many prospects require better delineation, and detailed reflection seismograph surveys yield excellent exploratory information when used in conjunction with adequate subsurface geological work.

If the area still has favorable possibilities, after the above studies, a detailed economic study should be made. Costs, expected reserves and market facilities should be determined. Also, a check on size of the offset leases and on the lessors should be made. If surrounding leases are small and held by numerous imprudent individuals or companies, an excellent reservoir can be turned into an economic failure by overdevelopment. Figure 3 is an excellent example of excessive development. If at all possible, 320-acre, or greater, drilling units should be provided at the outset to insure optimum spacing. Smaller units can be formed later if closer spacing then is considered advantageous.

History. The Wilcox trend area of South Texas first began producing oil in about 1929 from shallow Cockfield Eocene reservoirs. (Pettus, Normanna, and Tuleta fields.) Reservoir energy was low and maximum recovery of oil necessitated close spacing and complete development of the fields.

The Thomaston and West Tuleta fields discovered in 1940, were the first typical downdip Wilcox gas fields to be drilled. North Pettus, South Caesar, Nordheim, Provident City, Vienna and Yorktown were discovered in 1941 and 1942. Generally, these were multipay fields with thin oil columns and large gas caps. There was no market for the gas. Cycling operations were expensive. Leases were small and held by many operators because of the earlier oil play to the shallow Cockfield Eocene horizons. Oil discoveries were few, drilling was expensive, recoveries were poor. In comparison, the Frio-Oligocene and Miocene trends were booming. The Wilcox simply did not offer the incentives to drill as did other areas.

Until 1947, United Gas Transmission Company was the only company offering an intrastate market to a limited number of Wilcox fields. During the period from 1947 to 1950, Texas, Illinois, Tennessee, and Transcontinental established additional lim-

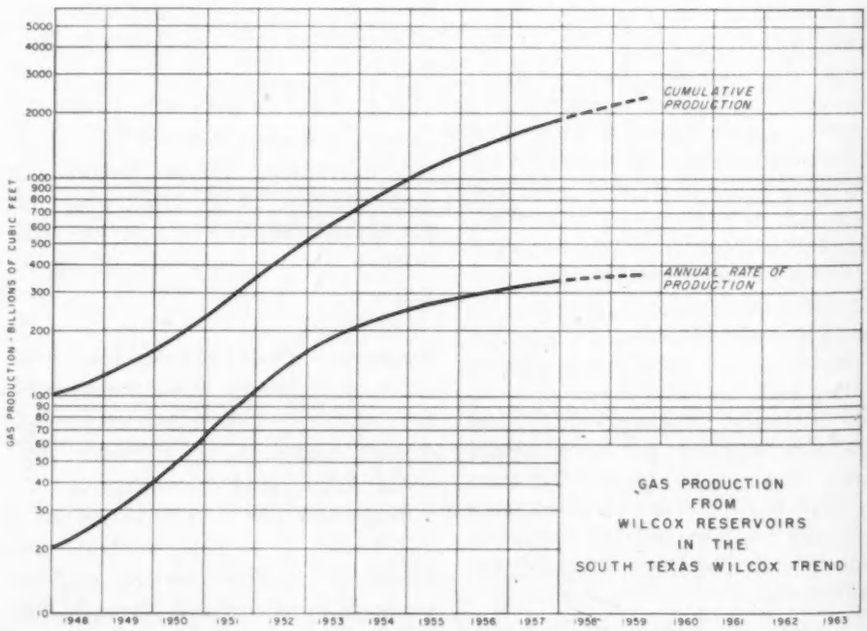

GAS PRODUCTION - BILLIONS OF CUBIC FEET
CUMULATIVE PRODUCTION
ANNUAL RATE OF PRODUCTION
GAS PRODUCTION FROM WILCOX RESERVOIRS IN THE SOUTH TEXAS WILCOX TREND

FIGURE 5—Here, gas production from Wilcox reservoirs is plotted versus time. The curve demonstrates a continuing increase in the annual rate of production, which could only be accomplished with increases in both market facilities and the availability of gas from additional wells each year. Some additional wells are new development; others are made available to transmission lines at the culmination of cycling operations and pressure maintenance programs. This curve indicates a very healthy situation where transmission and market facilities are being expanded from year to year at a rate that keeps pace with an increasing amount of available gas.

ited markets for parts of the Wilcox trend. In 1953, Wilcox Trend Gathering System, Inc. built a line from Duval County to Lavaca County. This offered a market to nearly all Wilcox fields along the trend. Since that time, additional intrastate and interstate lines have continued to compete for the available gas. With competition between the transmission companies, prices for gas have continued to go up, increasing the incentives to drill and develop new areas.

Economics. Figure 4 shows the new field discovery rate for wildcat wells testing the Wilcox formation. During the first six months of 1958, the new field discovery rate has averaged one discovery for every four wildcats drilled and exploratory wells have averaged one completion for every 2.9 wells drilled.

Within the 11-year period from 1946 to 1958, 886 exploratory wells were drilled. This resulted in 96 new oil wells and 185 new gas wells. As of January 1, 1958, there were approximately 750 oil and 950 gas completions in Wilcox reservoirs within the 193 fields considered herein. The fields involved have produced approximately 100,000,000 barrels of oil and condensate and 2 trillion cubic feet of gas.

The current annual rate of production is 7,640,000 barrels of oil, 2,100,000 barrels of condensate and 260 billion cubic feet of gas. Using today's average prices for oil, condensate and gas, these figures indicate the average gross income for a gas completion to be $37,000 per year, and for an oil completion to be $34,000 per year with 15 producing days per month. Income from a single gas completion would have about a three-year payout. However, 80 of the 193 fields under consideration have multiple pays in the Wilcox formation where normal procedure is to dually complete the wells. The dual completion program reduces payout periods considerably. Many more of these fields have shallower Frio, Vicksburg or Yegua pays. However, these are not usually dually completed with a Wilcox zone.

The statistical average Wilcox well in this area has a gross ultimate of 5.3 billion cubic feet of gas and 80,000 barrels of condensate. The calculated ratio of gross income to invested capital is more than 6 to 1 for this well. With greater care in the selection of prospects and the acquisition of larger leases, and average ratio of 10 to 1 probably could be obtained. This is a good return in any oil province.

Future activity. Exploration drilling activity as illustrated in Figure 4 indicates what has happened along the Wilcox Trend to date. Extrapolation of these curves gives a favorable indication of what might be expected over the next three to five years. The average price for gas has been increasing each year and with initial condensate recoveries ranging between 20 and 60 barrels per million, incentives to drill in this area are becoming more favorable.

In the early years of Wilcox Trend development, oil was the primary objective. Gas shows were regarded with little importance since no market facilities were available. Furthermore, in the limited areas where market facilities were available, prices paid generally would not justify setting pipe and testing, except where sands were unusually well developed and had thick pay sections. Development and the re-drilling of old dry holes during recent years has proved that many gas fields were bypassed during initial activity in the trend. It is reasonable to expect the logs and records of other old wells will lead to the discovery of additional new fields. However, detailed geological studies and geophysical surveys will contribute most toward discovery of new fields in the Wilcox trend.

The best prospects for substantial Wilcox discoveries today and in the near future are within the lower members of the Wilcox formation which have been inadequately tested, and the downdip Wilcox at depths of 7,500 to 10,000 feet. These are more hazardous exploration areas than the main trend because the sands tend to be tighter and more erratic. Subsurface control is limited and drilling problems are amplified by abnormally high pressures and temperatures. However, there are a number of good fields along the trend at these depths which indicate the gamble is worthy of consideration. Usually, condensate yields are 50 to 100 percent greater than yields at depths between 6,000 and 7,500 feet. The Piedre Lumbre, Hagist Ranch, Hostetter, Baker-Wilcox, Tom Lyne, Clay West, Normanna, Dial, Meyersville, West Mission Valley and Helen Gohlke fields have reserves indicated in excess of 40 billion cubic feet of gas per field. Many of these fields will ultimately produce more than 100 billion cubic feet of gas, and all have multiple pays.

Future availability and markets. Figure 5 indicates a continuing increase in the annual rate of production. This increase could only be accomplished with an increase in market facilities and an increase in the availability of gas from additional wells each year. A very healthy situation is indicated.

It is estimated the proved gas reserve of the Wilcox trend of South Texas is 3.5 trillion cubic feet of gas as of Jan. 1, 1958. Approximately 2.5 trillion feet now are dedicated on long term contracts to transmission lines and other markets. Another trillion feet are tied up in gas cycling and pressure maintenance programs and will become available to the market within the next ten years. During that time an additional 2.0 trillion cubic feet of gas should be discovered in new fields, new pays and by additional development. —**The End**

About the Author

Fred L. Oliver received a B.S. degree in geology and a B.S. degree in physics from The University of Texas in 1951. He was employed by Stanolind Oil and Gas Company as a geological oil scout and exploration geologist from January, 1951, till December, 1952. He was employed as a reservoir and geological engineer with DeGolyer and McNaughton from 1952 to 1958. In January, 1958, he opened a consulting geological and petroleum engineering office with Frank West as a partner.

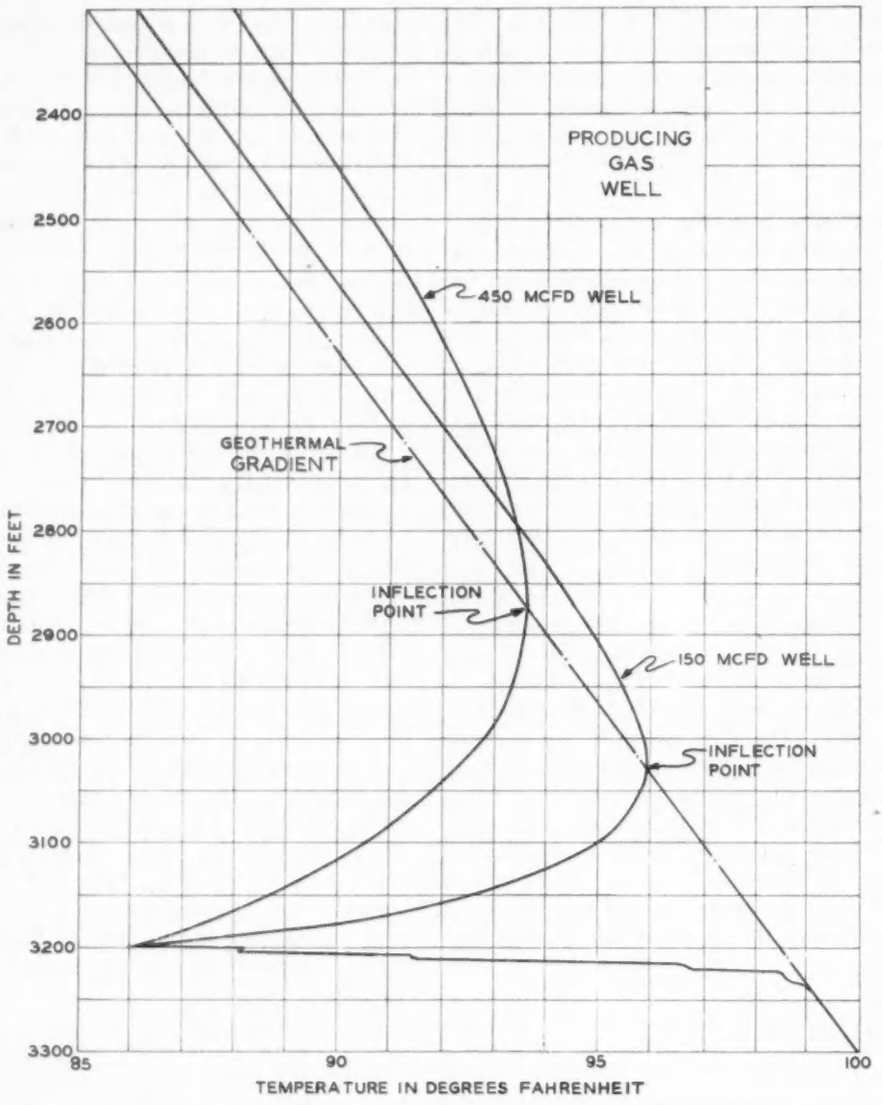


FIGURE 1—An idealized set of temperature logs for gas producing wells is shown. Gas and earth temperature are equal at the point where the curves become vertical (inflection points).

Temperature logs aid gas storage well analysis

Here is the practical signficance of patterns which have emerged from proper interpretation

By James M. Bird, President, and **John C. Dempsey,** Petroleum Research Supervisor, Birdwell, Bradford, Penn.

ACCURATE TEMPERATURE logs have been valuable aids to the natural gas industry in producing wells for many years. Since the development of more sensitive temperature logging devices, new quantitative and qualitative uses for these logs have become possible. Characteristic and repeatable patterns have emerged for different well conditions in gas storage wells. This is an attempt to explain their theoretical and practical significance.

Producing condition. Temperature logs of primary producing gas wells have been treated in a previous paper.[1] There is no essential difference in the character of temperature logs of storage wells taken under the producing condition. The usefulness of these logs consists in their ability to locate the producing zones and to indicate the relative amount of gas flowing from each horizon in the case of multiple pays. As brought out in Reference (1), this latter use is accomplished by comparing the mass flow sensitive parameter $\triangle$ as taken from the low above each pay

where

$$\triangle = (T_g - T_e)\ (dh/dt) \qquad (1)$$

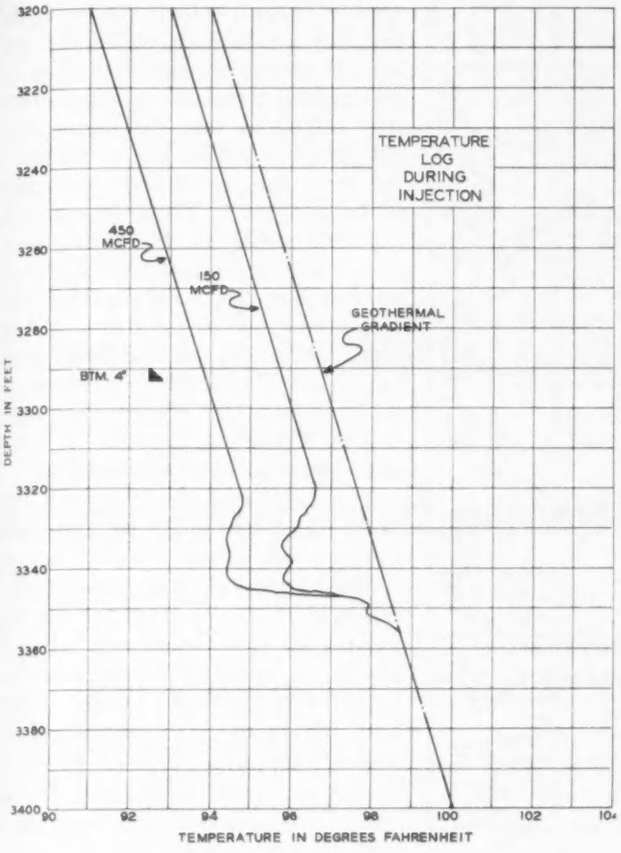
T_e = Temperature of the earth at the depth being considered.

T_g = temperature of the gas at the depth being considered.

dh/dt = slope of the log at the depth being considered.

Since the fraction $\triangle_1$ over $\triangle_2$ is independent of the density of the flowing medium, it applies equally well to logs run with or without back pressure; therefore, producing logs can be used validly for the above purposes in situations where the well cannot be blown open, as in the case of high-volume wells.

To review the shape of temperature curves at various production rates and their relation to the geothermal gradient, Figure 1 shows an idealized set of temperature logs in gas-producing wells. The two curves represent production rates of 450 MCFD and 150 MCFD, as shown. The entrance temperature of the gas is relatively independent of the flow volume, so it is shown to be the same for each



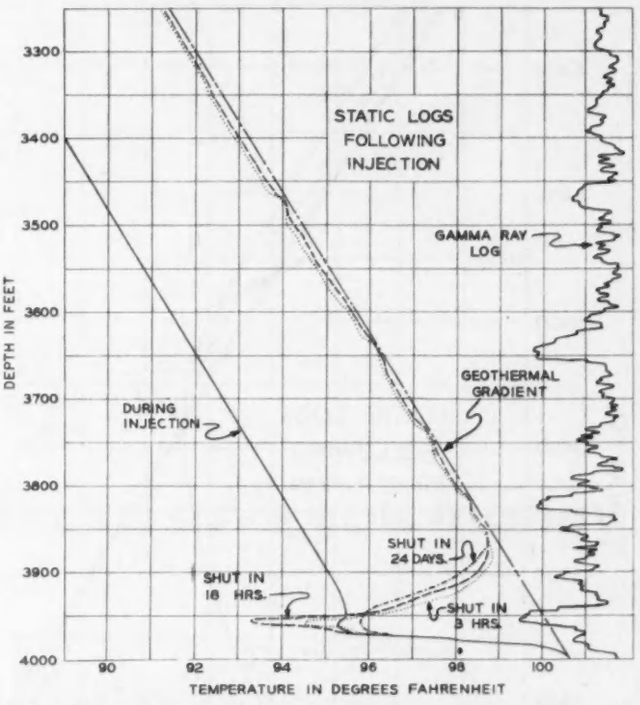


FIGURE 2 (left)—Here is an idealized set of temperature logs in a gas storage well during an injection period. Note that the temperature of the flowing gas reaches the bottom of the well almost parallel with the gradient.

FIGURE 3 (above)—These static temperature logs were taken at varying intervals after gas injection into a storage well. Notice that the temperature opposite the zone of interest tends to decrease temporarily before undergoing a very gradual warming.

production rate to eliminate this variable from consideration.

At the point where the temperature log is vertical, the flowing gas is experiencing no change in temperature. This must be the point where the gas and the earth are at the same temperature. These points on the geothermal gradient are marked on Figure 1 as the "Inflection Points." The gas is cooler than the earth's temperature below this point and warmer above it.

Experience has shown that in order to obtain a valid log, the condition imposed on the well for logging must be maintained constant for some time prior to entering the well so as to establish a condition of thermal equilibrium in the well. Usually, three or four hours are sufficient for this purpose, but smaller wells sometimes require 24 hours or more to eliminate transient thermal effects. This often makes it impractical to use the producing condition in working with storage wells.

Temperature logging during gas injection. Figure 2 shows an idealized set of temperature logs in a gas storage well during injection. The two logs represent wells taking 450 Mcfd and 150 Mcfd. In both cases, the temperature of the flowing gas reaches the bottom of the well practically parallel with the gradient. Once this parallel condition is reached, the horizontal distance of the temperature log from the gradient is directly proportional to the amount of gas flowing. This follows from Equation 1, since the slopes of the parallel lines are equal.

During injection, the pressure drop and the associated cooling all take place in the sandstone itself. The continual influx of gas acts to sweep this cooled gas back into the rock, thus preventing it from directly influencing the temperature in the well bore. However, in time, this pressure drop acts to refrigerate the pay, and, by conduction, the zones in contact with the pay.

As a result, the gas flowing down the well adjacent to these refrigerated zones is cooled in transit. Thus, the temperature log generally shows a slight cooling through the area of the pay even during gas injection. Usually, very little information can be gained from logs run under this condition. Even the location and extent of the pay are usually uncertain because the cooling anomaly is always small and often appears to extend through the beds in contact with the pay.

Logically, this residual cooling of the rock caused by this refrigeration effect should be present to some extent throughout the effective gas storage reservoir. The movement of gas through pores must be accomplished by a pressure drop, and according to Charles' Law, a cooling must accompany every pressure drop in a gas. Residual cooling, then, must be caused by the flow of gas both into and out of the storage reservoir. Field work has indicated such cooling to be

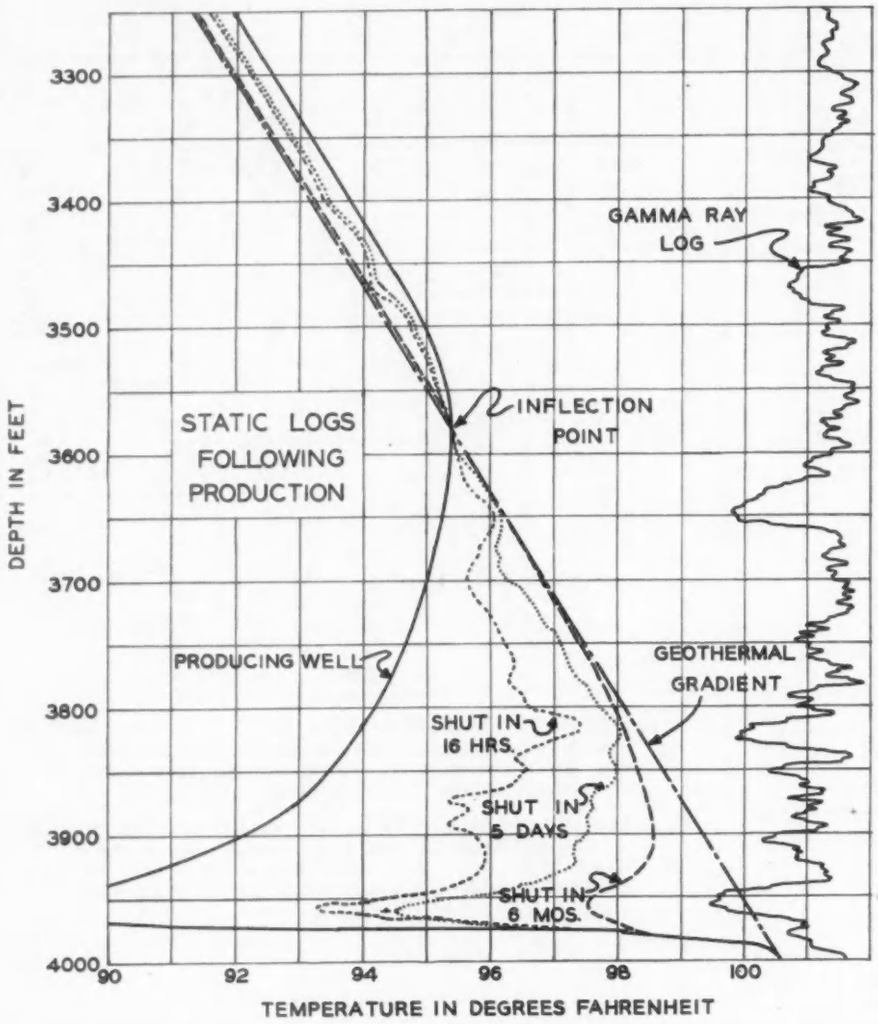


FIGURE 4—The static temperature logs shown here were obtained from a storage well following a producing period.

present in the reservoir considerable distances from wells actually in use.

Static condition. Useful information can be obtained from temperature logs of storage wells while they are shut-in. The validity of logs taken under this condition depends on the prevention of lubricator leakage while entering and logging the well. The residual cooling described previously is the cause of the anomalies generally observed through the pay zones on such "static" logs. The magnitude of the cooling under this condition is many times that observed during injection, because here there is no gas moving into the rock to prevent heat conduction back into the well bore.

Figure 3 shows a series of static temperature logs taken at various time intervals after injection. As shown, the degree of cooling present changes with time after injection is discontinued. It is interesting to note that the temperature opposite the pay tends to decrease temporarily before undergoing a very gradual warming. This indicates that the coolest temperature during injection is some distance out in the formation rather than immediately at the well bore where the constant influx of warm gas had counteracted the residual cooling somewhat.

A similar set of curves taken under this condition shows the lowest temperature opposite the pay. This is reasonable because the pressure drop and accompanying residual cooling are at a maximum nearest the well bore in the absence of the counteracting thermal force mentioned above.

Under this condition, an interesting phenomenon occurs for some distance above the pay, which results in the peculiar anomalies above the permeable section in Figure 4. The superimposed producing temperature log indicates that the temperature through this section was considerably less than the geothermal gradient while producing. The cold gas moving continuously by this section previously has drained the normal heat content out of it. This cooling thus conducted into unproductive beds may best be termed "inducing" cooling. These beds tend to warm up more or less quickly according to the degree of cooling imposed on them, and, also, their heat conductivity.

It is this latter effect which causes the peculiar excursions of the curve through this interval. Each anomaly on the temperature log is seen to correlate with a specific bed on the gamma log. The temperature of sands which are better heat conductors approaches the gradient more quickly than that of the shaly sections.

It is interesting to notice on Figure 4 that above the inflection point the temperature anomalies are reversed in the respective beds. During production, the gas is seen to be warming the earth here. Sand temperatures still "lead" the shales toward the gradient, but here the gradient is cooler.

Due to the exponential nature of heat transfer, all changes in temperature logs tend to proceed very slowly after a relatively short time. Substantial residual cooling has been detected six months after a field was shut-in.

Logs taken under static conditions usually are best for detecting leakage. For this purpose, producing or injection gas presents additional variables which serve only to confuse interpretation.

Thief zones, plug backs; casing, tubing, and packer leaks; channeling in cement, and migration of gas from one permeable zone to another can usually be detected satisfactorily with static temperature logs.

Temperature logs in gas storage wells usually can be interpreted successfully, adhering to the principles outlined above, and can be a help to the reservoir engineer in solving some of his problems.

REFFERENCE

[1] American Petroleum Institute (1954) Interpretation of temperature logs in water-and gas-injection wells and gas-producing wells: Drilling and Production Practice, pp. 187-195.

PART 6: THE DISCHARGE PRESSURE AND SYSTEM

Know your mud pump—it can save you money

Hydraulic pressure losses must be understood for efficient drilling operations

By Samuel L. Collier, Research Engineer
Mission Manufacturing Company, Houston

THE MUD pressure on the discharge side of the system has a complex character. This pattern is a result of the interaction of the mud pump piston motion and the characteristics of the hydraulic system into which the mud is forced. Field understanding of these two factors will improve operations and equipment life.

Pump pattern pulsates. A mud pump has a pulsating discharge flow pattern. This is a result of variation in piston speed throughout the pumping stroke. This is shown in Figure 2 (WORLD OIL, July, 1958, Page 101) which shows how the rotary motion is transferred into reciprocating motion by the crank and rod of a power pump. This is a sine curve. This pattern results in a much higher piston speed and above average flow rate near the center of the stroke.

System friction curve. The pressure loss through the surface pipe, drill string, bit and return annulus depends on:

- Pipe size
- Pipe length
- Fitting number and type
- Mud flow-rate
- Mud weight and viscosity
- Bit type
- Annulus area
- Rotation

All of these factors must be considered when calculating the pressure loss for a specific system. This data can be obtained from various published charts and tables. However.

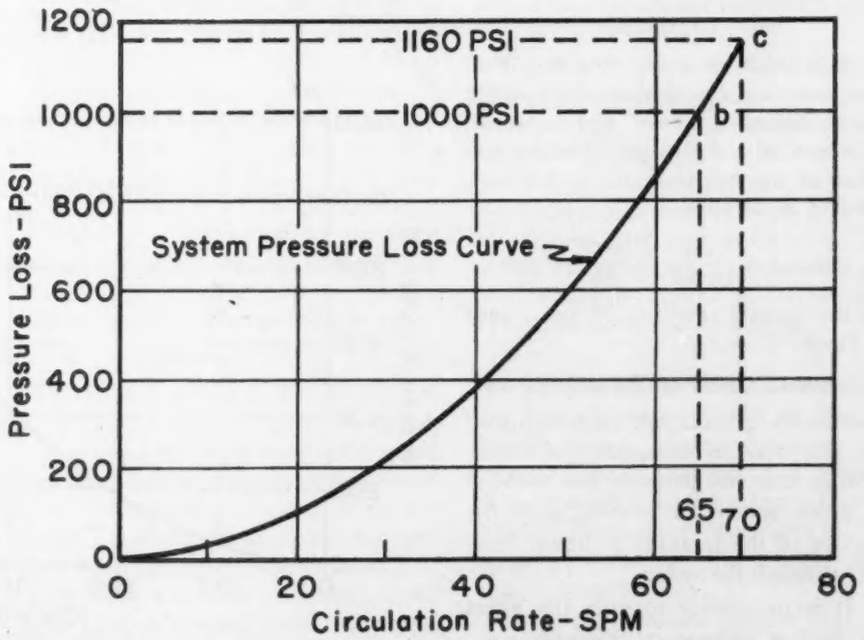


FIGURE 28—The complete curve for a given system can be drawn once the pressure loss is calculated at a given circulation rate.

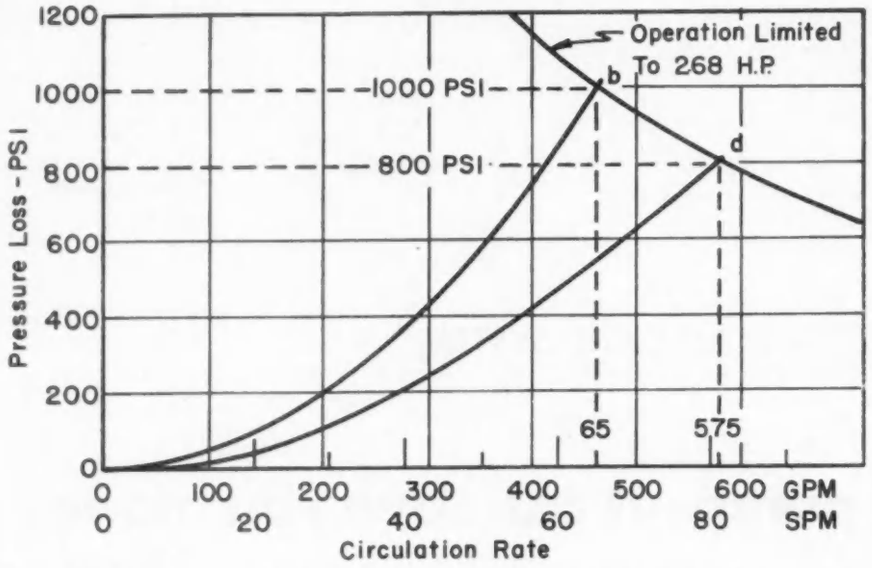


Figure 29—The power may be limited; however, the operational characteristics are not.

several items can be learned from a more general understanding of this system.

The entire typical curve such as that shown in Figure 28 can be drawn easily by calculating one point (b) at a given flow (spm) and well depth.

The application of two simple hydraulic laws will thus complete the curve. They are as follows:

A. The curve must go through the zero pressure point at the point of the zero flow.

B. The pressure loss is generally proportional to the square of the flow. Thus the system friction curve is a parabola where:

$$\text{psi} = \text{constant}\ (\text{spm})^2$$

The constant is easily obtained from the complete calculation of the single point described above. For example, if there is a 1,000 psi pressure loss operating 6¼-inch liners (16-inch stroke) at 65 spm.

$$\text{Constant} = \frac{\text{psi}}{(\text{spm})^2} = \frac{1000}{65^2} = .237$$

If the speed is raised to 70 spm (point *c* Figure 1).

$$\text{psi loss} = .237\ (70)^2 = 1160\ \text{psi}$$

Additional points could be determined in this way to complete the curve. Notice that the pressure loss through a given system increased with the square of the quantity of liquid flowing through the system.

It is interesting to note the effect of such a change on horsepower. Power is the product of pressure and flow. Thus, the horsepower increases with the cube of the flow rate through the system. Therefore, the hydraulic power required with the change in speed from 65 spm to 70 spm would be $\left(\frac{70}{65}\right)^3$ or 1.25 times as much power. This drilling system would require a 25 percent increase in horsepower to overcome the 16 percent increase in pressure loss that developed from an 8 percent increase in circulation rate.

From this it can be seen that the correction of a poor annulus velocity by raising pump speed would be costly in terms of power required. This illustrates the importance of a good drilling program with low pressure drop through the drill string and annulus so that pressure drop can be controlled by bit selection. This will result in the most effective use of the power available.

The behavior of the system friction curve leads to some interesting conclusions since the pressure loss for a given set of equipment will not change unless the flow rate changes.

1. The system determines the pressure and the power while the mud pump limits this to its power capacity.

2. The addition of boosting or series pumps at a given spm cannot raise the pressure unless the system pressure losses are changed.

3. The discharge system determines the variation of the pressure pattern during an individual stroke of the pump.

The system determines the pressure and power. The system determines the pressure and power because the pressure loss is dependent upon the size and shape of the discharge piping. Thus, when the pump is at rest and no mud is flowing, the pressure loss is zero. When a belt driven pump is started, the flow generally increases; however, the pressure loss rises much more rapidly. The flow can be increased until the power capacity of the driver is reached. Each speed gives definite values of pressure loss because it represents a certain flow.

For a given discharge system the same pressure loss curve would be ob-

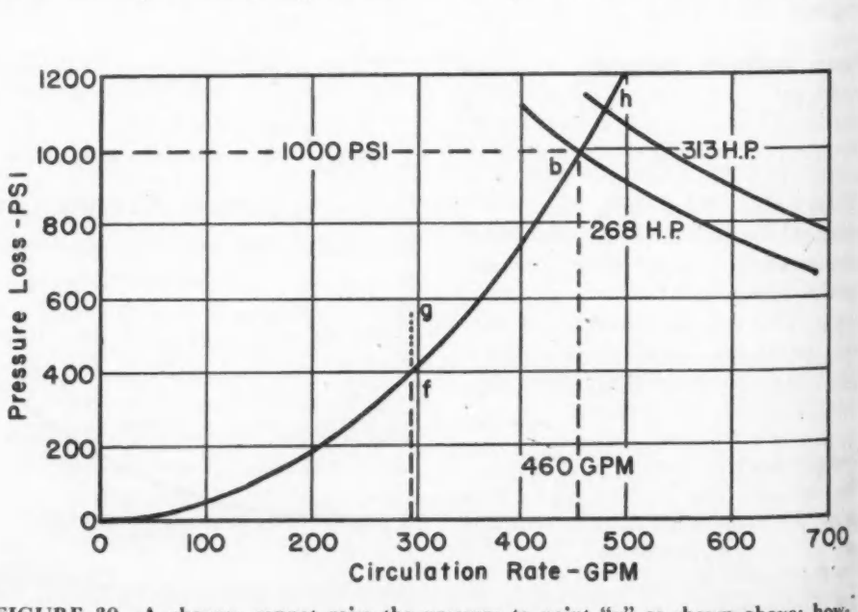


FIGURE 30—A charger cannot raise the pressure to point "g" as shown above; however it does raise the limiting power and the maximum flow.

tained if the above procedure were rerun for various pump liner sizes. The pressure loss would be the same for a given flow with different liners; however, the pump speed would differ. In the previous example, a pump equipped with 6¼-inch liners, operating at 65 spm will circulate 460 gpm and develop a system pressure loss of 1,000 psi. Since 7½-inch liners are larger they would produce the same flow (460 gpm) and the same pressure (1,000 psi) at 44 spm. Thus, changes in the pump cannot affect the system pressure loss curve.

A change in bits to one with larger nozzles will produce system pressure drop curve *d* (Figure 29).

The hydraulic horsepower at 1,000 psi and 460 gpm on curve *b* is 268 hp $\frac{(1000 \text{ psi} \times 460 \text{ gpm})}{1714}$. A test run along curve *d* with a properly coupled engine could be run out to 575 gpm where the pressure loss is 800 psi. The hydraulic horsepower at this operating point is:

$$\frac{800 \text{ psi} \times 575 \text{ gpm}}{1714} = 268 \text{ hp (for water)}$$

Thus, changes in the system alter the pressure that is developed while the pump and engine determine the limits of the curve.

Series pumps do not raise the pressure. The addition of a charging or series pump when operating at a given mud pump speed will not raise the discharge pressure. It may be necessary to run pumps in series to develop a high pressure for deep wells and jet drilling. The main pump which is operating at a fixed number of strokes per minute determines the quantity of liquid that will enter the system. The system requires a certain pressure for any given flow. The pressure does not rise to a point such as *g* Figure 30, but must stay at point *f*.

A very slight rise in pressure may occur because the charging pump takes some of the horsepower load from the main pump engine especially when the charger has a separate driver. This happens because the mud enters the main pump with a charged pressure and does not require as much additional work to force it into the system. If the engine's speed is controlled, no rise in pressure occurs. However, if the engine is controlled by manifold pressure, it will speed up. When the limiting speed (b) Figure 30 has been reached on the system curve without the charger, additional power is available and the limiting conditions are raised. In our example, a 60-hp charger would give an additional 45 hydraulic hp making 313 hydraulic hp available, Figure 30 point *h*. This would increase the flow to 485 gpm, a 6 percent improvement, which would be obtained by raising the main pump speed to 68 spm. Knocking would not develop because of the charged suction. The pressure required at the new flow would be $\left(\frac{68}{65}\right)^2$ 1,000 = 1,115 psi, nearly a 12 percent increase. To realize this gain, the main pump must be set up so that the speed can be raised to the required amount. Also the centrifugal pump must develop the extra pressure at this new flow rate. Piston pumps operated in series will encounter the same problem. The main pump speed will determine the quantity of mud flowing into the system when suitable accumulators are placed between the pumps. This arrangement can be used when the system curve becomes very steep as in Figure 31 curve *m*.

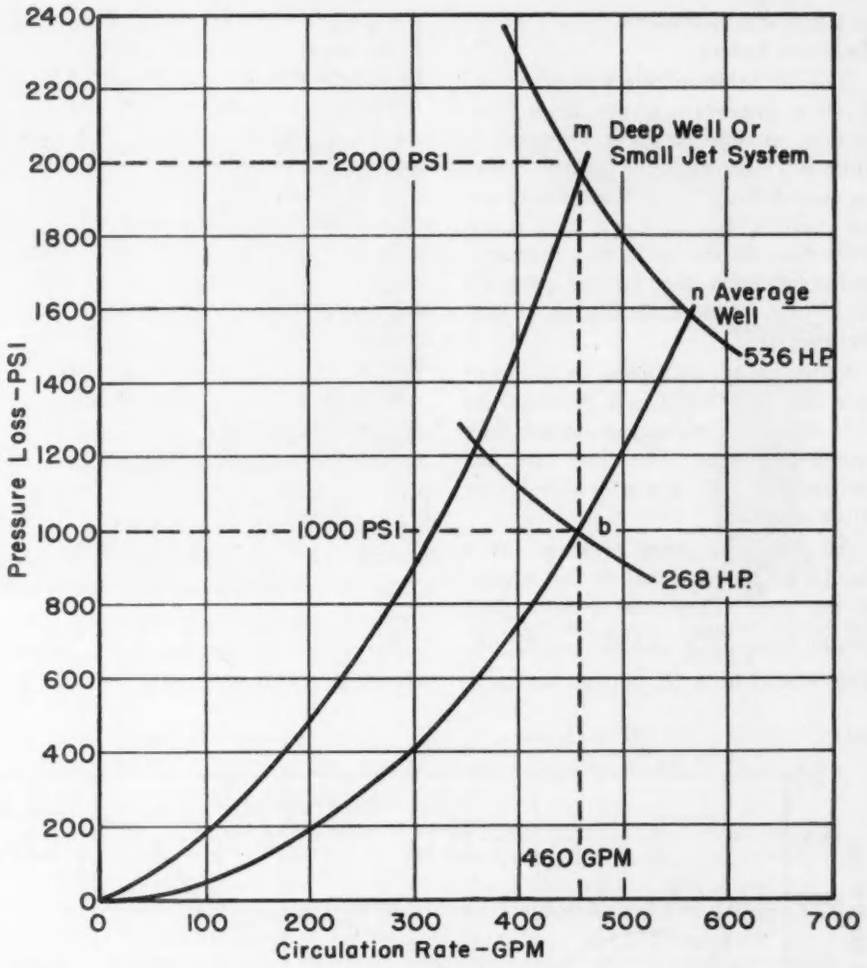


FIGURE 31—The main pump is run at nominal speeds to obtain normal circulation rates. A series pump is used in conjunction with the main pump when a high pressure drop system is anticipated.

The main pump operating with a high-pressure drop system *m* would be limited to 360 gpm providing the hydraulic hp input were held at 268 hp. If two pumps were run in series the main pump would deliver 268 hp and circulate 460 gpm at 65 spm. The system pressure losses of the deeper well would be 2,000 psi while the hydraulic hp would be 536 hp.

The discharge system determines the pressure pattern during a stroke. For a particular system, the pressure loss at any instant is nearly proportional to the square of the velocity. Normally all velocities in the discharge system will be proportional to the piston velocity.

Thus, the pressure pattern during an individual stroke is a reflection of the motion of the piston and the pres-

sure loss characteristics of the entire discharge system.

The variation during a single stroke is not as important to the drilling operation as the pressure required to force mud through the system under various drilling operations. However, the pattern that develops in a single revolution shows the factors that normally influence the drilling pressure on a longer time scale during changing operation.

Figure 32 shows typical variation of flow during a 360-degree rotation. At 188 degrees the instantaneous flow rate is 377 gpm. The flow rate has increased to 489 gpm at a 224-degree crank angle.

All the drill string pressure losses should be proportional to the square of the flow. Thus, the pressure loss should be $\left(\frac{489}{377}\right)^2$ 2,890 = 4,890 psi. This would be a 69 percent increase. The pressure should rise to 4,890 psi if the mud was incompressible and discharged through a rigid line.

The pressure peaks recorded in Figure 33 during laboratory tests were approximately 3,450 psi, while the pressure surge was 560 psi. Fortunately, the surges recorded in tests such as this are usually not as large as the estimated amount. The pressure rise is offset by the compressibility of mud, line expansion and other factors.

At approximately 60 spm when a revolution takes one second, the time for a change from a low to a high pressure point (point *a* to point *b* Figure 33) will be one-eighth of a second. The pressure pattern moves along the drill string at the speed of pressure propagation in the mud. This is the same as the speed of sound which is 4,000 feet per second in water. The pressure wave generated by a 36-degree movement of the crank will have time to travel about 500 feet and is able to compress mud along that entire distance. The excess volume pumped into the pipe line (unshaded area Figure 32) is about 30 cubic inches. Although the mud compressibility and pipe swell totals about one-fourth of a percent, the large volume effected in the 500 feet of pipe is enough to accommodate the 30 cubic inches. Thus, surge effect is reduced considerably.

The pressure surges in the discharge system do tend to dampen out with distance from the source of the variation. This is shown by the additional trace recordings in Figure 33 in which the variation in pressure has dropped to half its original value after passing through the five expansion chambers shown in Figure 34. These chambers

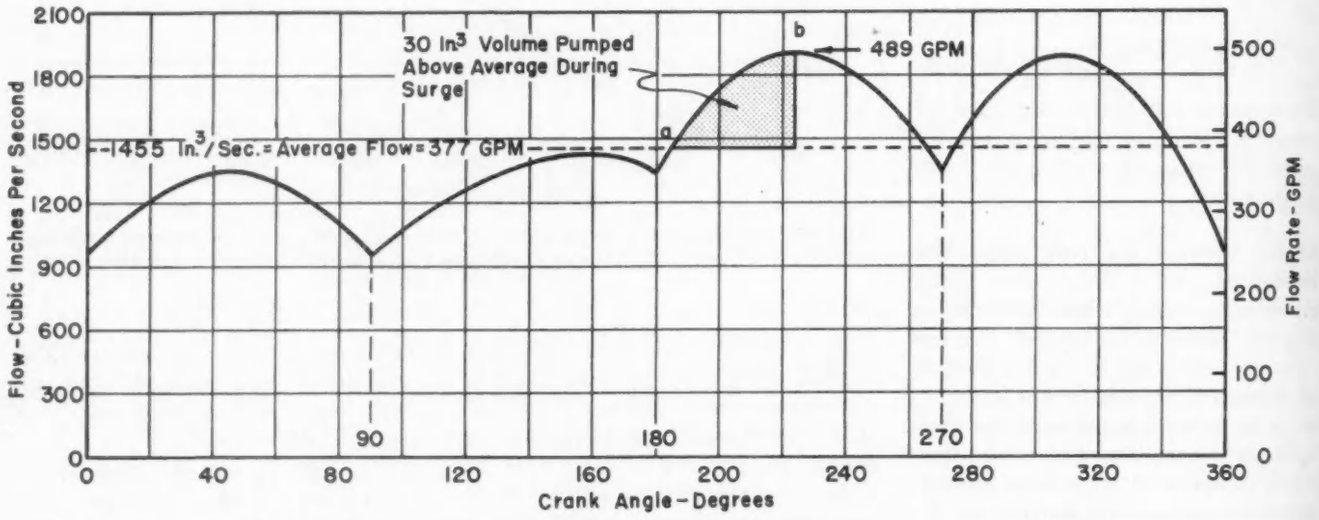


FIGURE 32—Here is a flow curve for an 8¼ by 18 mud pump at 60 spm.

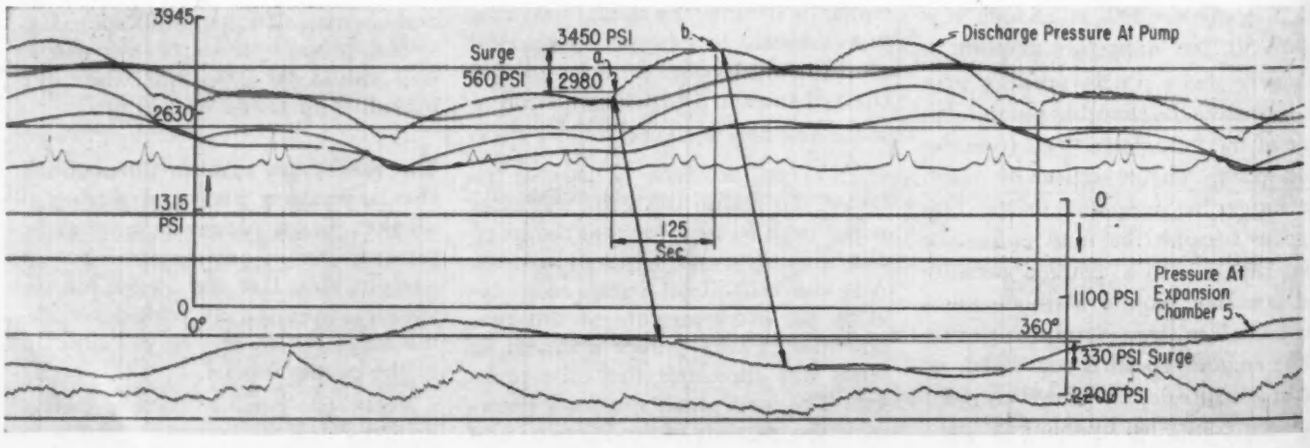


FIGURE 33—An actual oscillograph recording of the discharge pressure on an 8¼ by 18 mud pump.

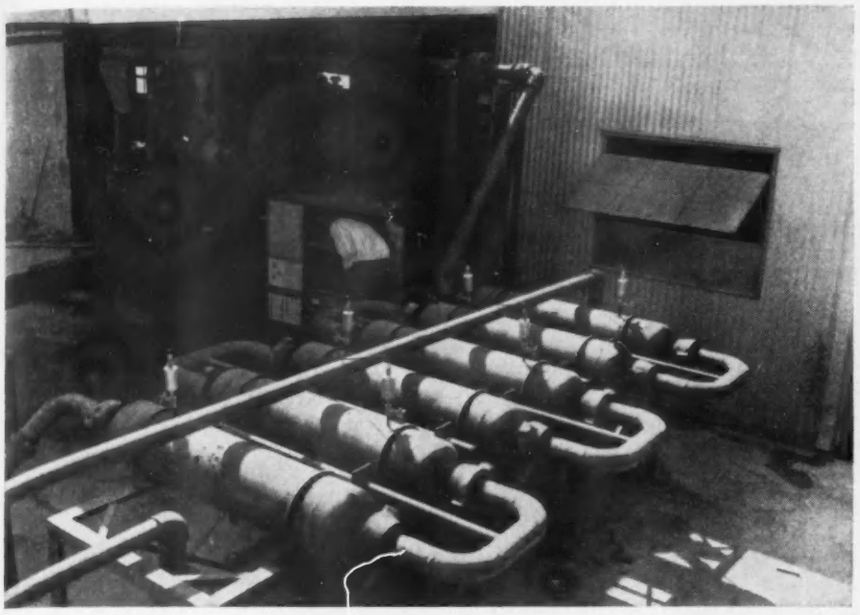


FIGURE 34—A series of expansion chambers used in the mud pump laboratory to simulate a string of drill pipe for volumetric and pressure relationships.

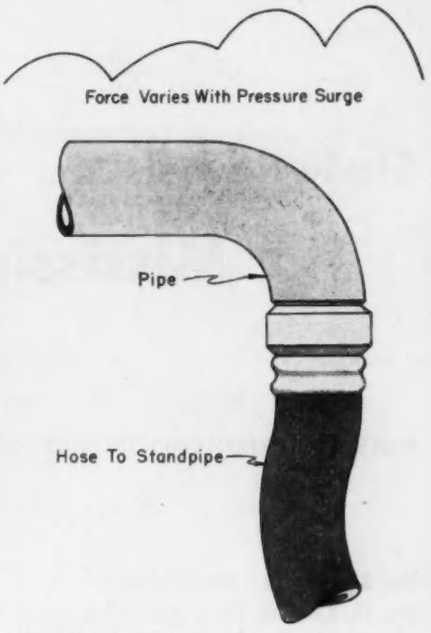


FIGURE 35—Severe internal forces develop with increases in pressure.

are normally full of mud and are used to duplicate the characteristic of a long drill string.

Some effects of normal pressure loss surges

• **Fatigue.** The pressure difference from *a* to *b* (Figure 33) is too small to be significant as a steady pressure on the pipe. However, this develops a varying stress which will eventually result in fatigue failure. The stress is the highest on the inside diameter of thick wall pipe. Since the mud is inside the pipe, corrosion fatigue is a factor. The stress condition normally varies from a certain tensile stress to a higher one, consequently, the problem is not as great as if there was complete stress reversal. At 60 spm, the stress varies eight times a second or nearly 700,000 load cycles per day. The stresses causing fatigue failure would most likely occur at fittings in the surface piping.

• **Vibrations.** Normal vibrations may be set up by the variation in velocity and pressure created in the discharge system. This may be a problem if the equipment is not securely anchored.

The change in flow velocity in the piping is proportional to the variations in the pump piston velocity. This is caused by the discharge piping being smaller in diameter than the piston. When a change in direction occurs, as in a 90-degree ell, this changing velocity causes a changing reaction at the ell. For example, the 30 percent variation in an earlier example would raise a 15-foot per second velocity to 20 feet per second, causing a change in reaction of about 15 pounds. This is slight; however, it could be much more if the cross section was necked down. At the same time, the system loss increases and the pressure rises from 2,890 to 3,450 psi, causing a change in reaction, Figure 35, of 560 psi x 12 square inches of area, or 660 pounds. This occurs four times per second at 60 spm. If the critical frequency of a piece of pipe happened to be about 240 cycles per minute, severe forces would be developed beyond the 6,615 psi reaction. The connecting hose would be subjected to the changing force and may swell, vibrate and whip excessively.

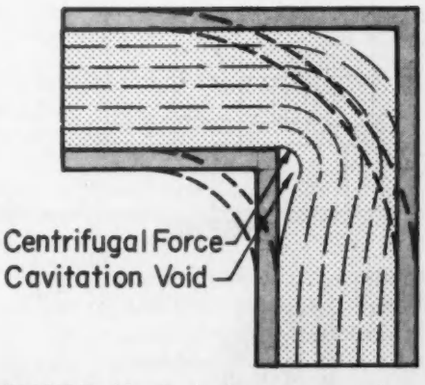


FIGURE 36—Cavitation occurs where fluid passes through sharp ells under high pressure.

Cavitation. This is more critical in pulsating flow rather than steady flow. Cavitation takes place when the pressure in the mud is too low to overcome centrifugal force. This may happen when ells are short radius or square as in Figure 36.

When the velocity is high and the radius short, the mud leaves the pipe wall and forms a cavitational void at the inside of the curve. The mud again contacts the pipe downstream due to a pressure movement in that direction. Audible crackling can be heard at this location. This results in cavitational erosion and abrasion wear. Vibrations are also developed. The condition is made worse by pulsations. Gas may vaporize in the void area and causes random vibrations when the gas bubble is washed along the pipe and then collapses. All piping in the discharge system should have large generous curves as shown by the dotted lines (Figure 36) to avoid this condition.

Although many of the problems caused by pulsating flow in the discharge system are difficult to evaluate, the elimination of these possibilities is desirable. The use of pulsation dampeners to accomplish this purpose is discussed in the next article of this series.

TO BE CONTINUED

Study Reveals . . .

Mississippi series possibilities

Report on Upper Madison group facies in northwestern North Dakota may improve correlation tasks.

By Sidney B. Anderson
North Dakota Geological Survey, Grand Forks, N. D.

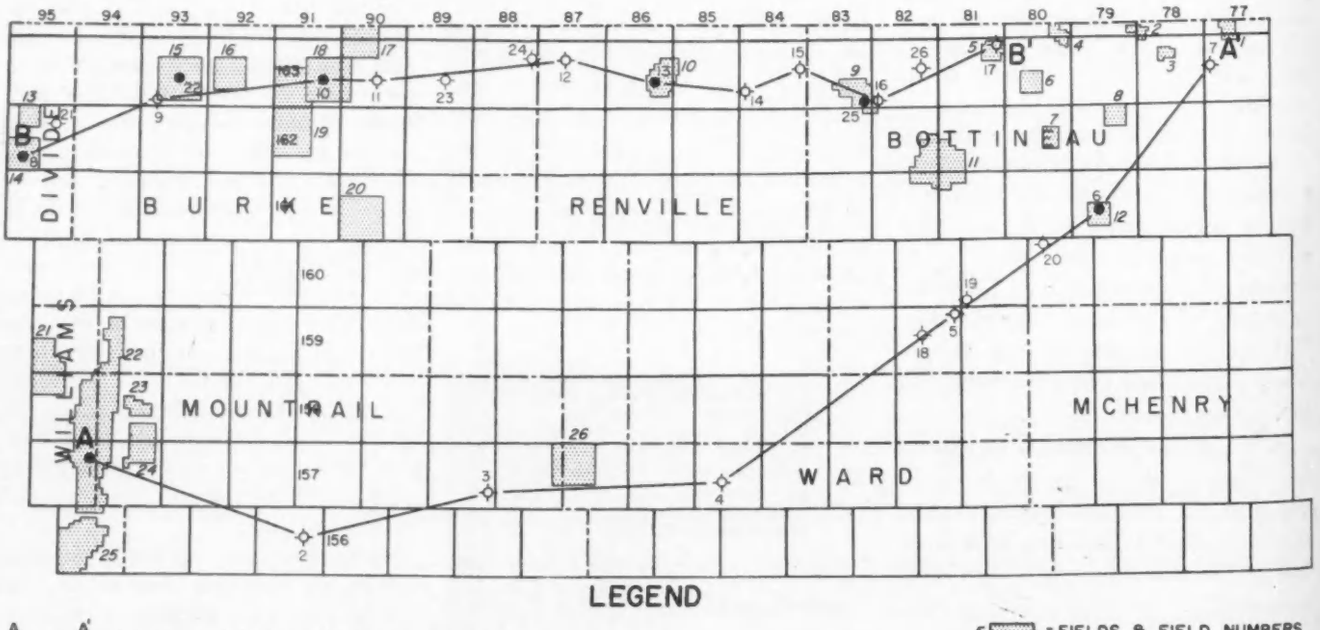
FACIES PROBLEMS of the Upper Madison group of Mississippian age in northwestern North Dakota long have been responsible for the confusion existing in correlation of the Mississippian system.

Names, definitions, correlations, occurrence, lithology and thickness of Madison group formations are offered in an effort to eliminate some of this confusion.

Description. Thickness of the Mississippian system is governed by regional thinning and post-Mississippian-pre-Triassic erosion. In the eastern half of the area, the Big Snowy group—which overlies the Madison group deeper in the Williston Basin—is missing; the Madison is unconformably overlain by the Spearfish "red beds" of Triassic or Jurassic age.

A secondary anhydrite cap has been deposited over most of the post-Mis-

FIGURE 1—Facies change in the Upper Madison group discussed extend from the northwestern to the northcentral portion of North Dakota in Townships 156 through 164 to the International Boundary within Ranges 77 through 95.



LEGEND

A — A' = LINES OF CROSS SECTION & WELL NUMBERS

5 = FIELDS & FIELD NUMBERS

1. NORTH SOURIS
2. NORTHEAST LANDA
3. SCANDIA
4. NORTH WESTHOPE
5. KUROKI
6. WESTHOPE
7. SOUTH WESTHOPE
8. LANDA
9. HAAS
10. BLUELL
11. WAYNE
12. NEWBURG
13. BAUKOL-NOONAN
14. NOONAN
15. COLUMBUS
16. RIVAL
17. ENTRY
18. FLAXTON
19. LIGNITE
20. COTEAU
21. McGREGOR
22. TIOGA
23. EAST TIOGA
24. WHITE EARTH
25. BEAVER LODGE
26. SOUTHWEST AURELIA

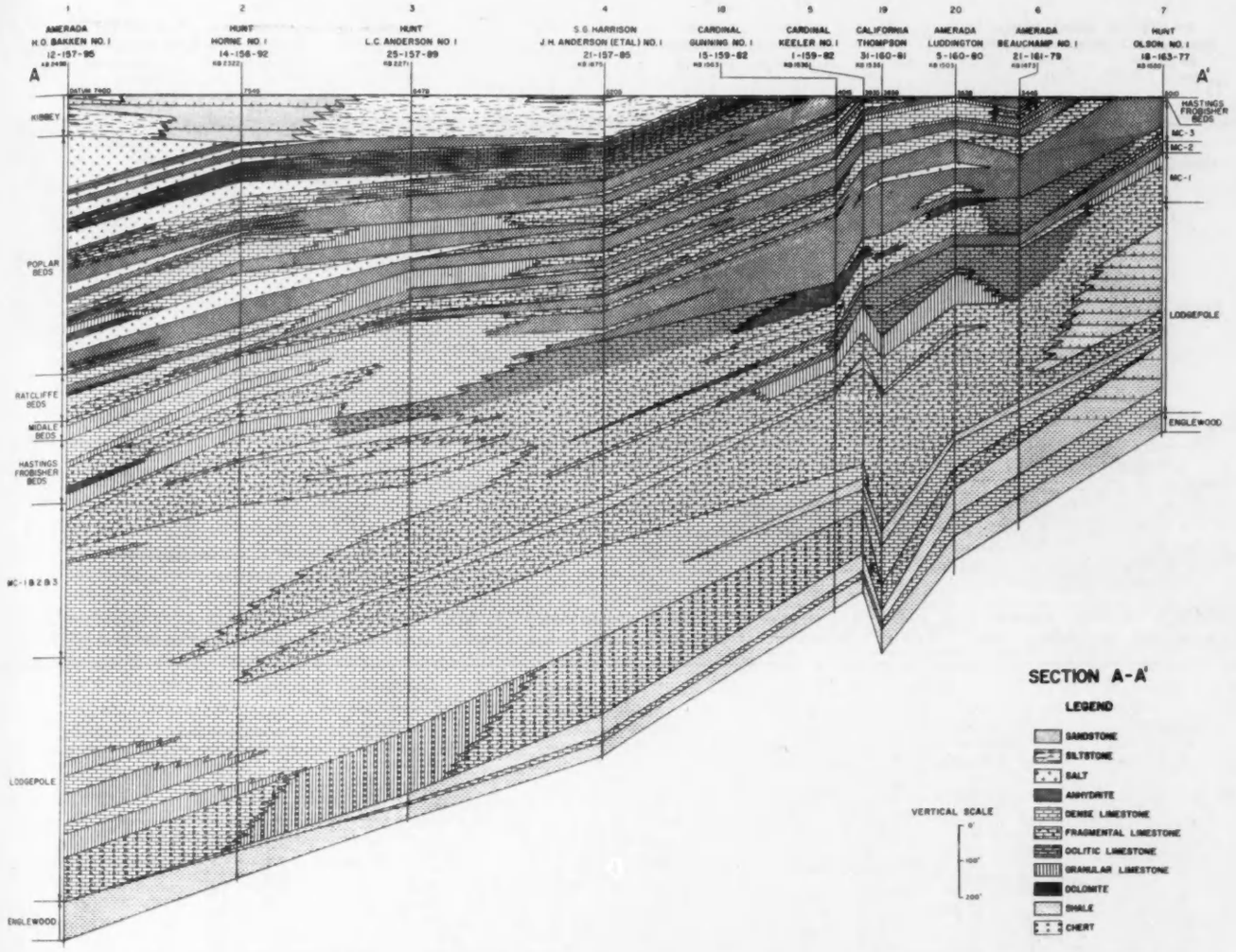


FIGURE 2—This geologic east-west cross section (A-A′) extends from Amerada Petroleum Corporation's H. O. Bakken 1, Sec. 12-157-95, Williams County, to Hunt Oil Company's Oliver Olson 1, Sec. 18-163-77, Bottineau County. This line of cross-section was selected as the area to demonstrate a number of facies changes, and more of the deeper wells necessary for control have been drilled along the line of this section. Datum for this cross-section is the base of the Kibbey limestone, or, where the Kibbey has been removed by erosion, the post-Mississippian unconformity is used as a datum.

The most striking facies change occurring on this cross-section is between the Wm. H. Hunt-L. C. Anderson 1, Sec. 25-157-89, and the S. G. Harrison-J. H. Anderson et al 1, Sec. 21-157-85. A large limestone section in the Hunt-Anderson well changes to anhydrite in the Harrison-Anderson well in a distance of 20 miles. This may be due to a barrier which impeded the circulation of water and caused deposition of anhydrite on the east, or shoreward, side.

Several good possibilities for stratigraphic traps are shown at the unconformity—between the Cardinal-Gunning 1, Sec. 15-159-82, and the California-Thompson 1, Sec. 31-160-81.

This illustration indicates an anomalous feature in the east part of the cross-section, which shows the California Company's Blanche Thompson 1 located in Sec. 31-160-81 to be structurally low on the Englewood and Lodgepole, with a thickening in the upper Lodgepole and lower Mission Canyon. This appears to have been caused by salt solution in the Devonian Prairie Evaporite section with a subsequent collapse of overlying beds.

The Thompson well had no salt in the Prairie Evaporite section, while Cardinal Drilling Company's Keeler 1, Sec. 1-159-82, about two miles distant, had 160 feet of salt in the section. The salt collapse apparently occurred during late Lodgepole and early Mission Canyon time, as evidenced by thickening of these parts of the formations.

The extent of this area of salt collapse is unknown, but it may have formed structural traps, particularly in the upper Devonian and Mississippian Lodgepole. At any rate, it effected Mississippian sedimentation in the area of collapse. (Anderson and Hansen, 1957.)[2]

sissippian erosional surface. This anhydrite may form an effective seal over some of the porous beds that have been truncated by erosion, thereby forming excellent stratigraphic traps.

Several facies changes exist in the area under discussion, notably changes from a limestone facies to an anhydrite facies or from porous limestone to dense limestone. The latter also may form excellent stratigraphic traps.

These porous horizons may provide excellent oil and gas reservoirs if they meet one or more combinations of the following conditions:

- If they contain permeability barriers
- If they are associated with structure
- If they are truncated by the Mississippian unconformity and overlain by a secondary anhydrite acting as a seal.

Obviously, the easiest to find are the porous horizons associated with structure. The other conditions are

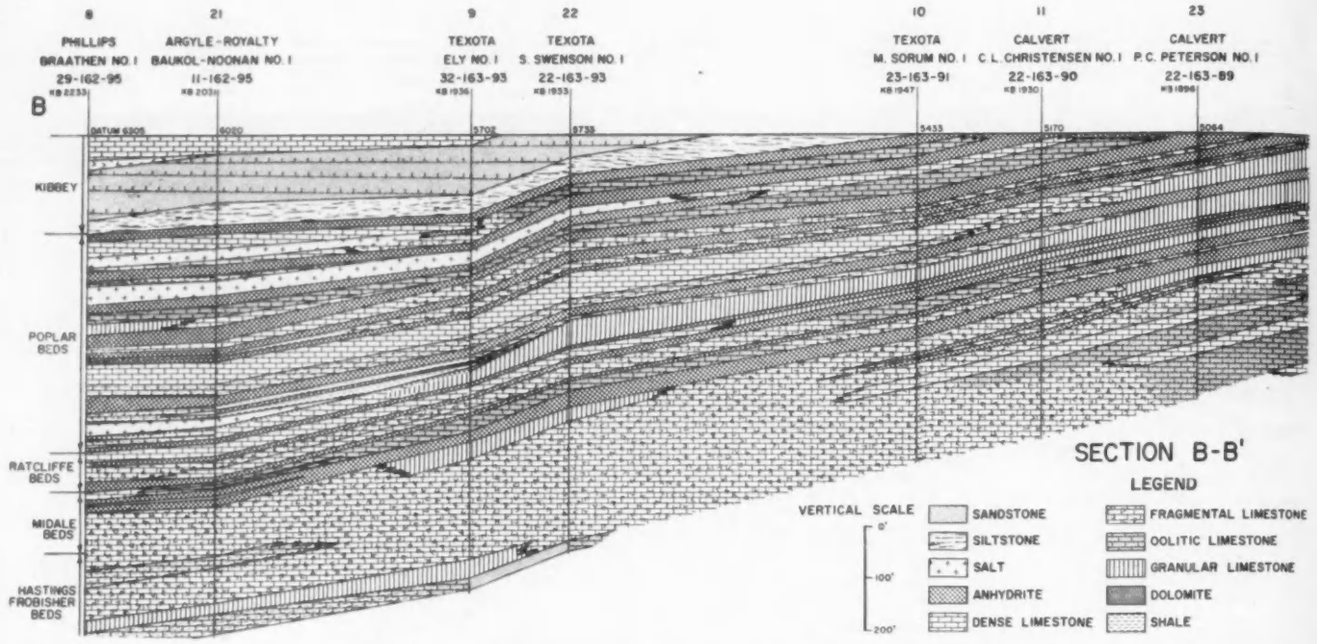


FIGURE 3—This cross-section B-B's is a geologic east-west cross-section extending from Phillips Petroleum Company's Braathen 1, Sec. 29-162-95, to Cardinal Drilling Company—U.C.L.I. 1, Sec. 1-163-81. Datum for this cross-section is the top

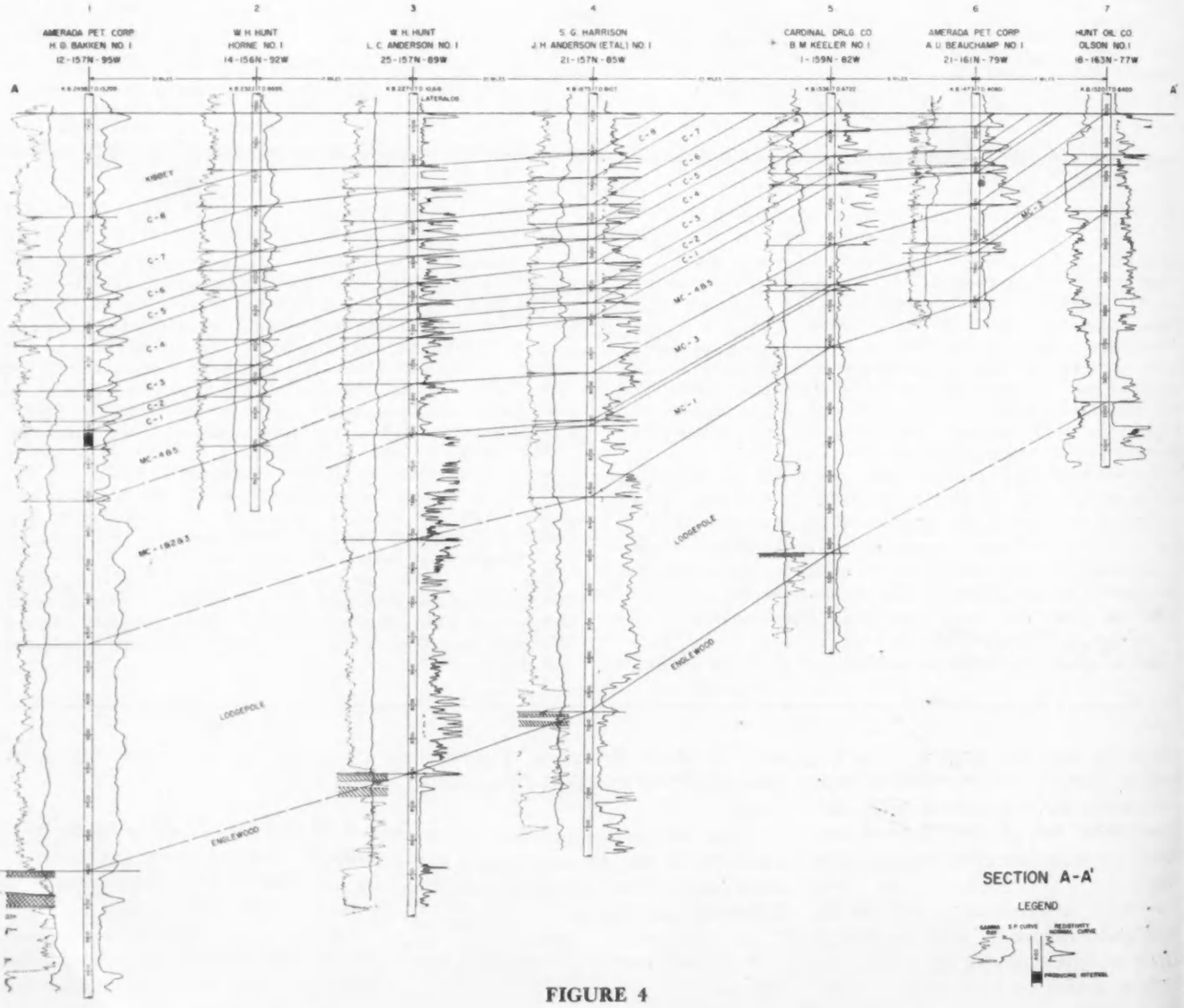
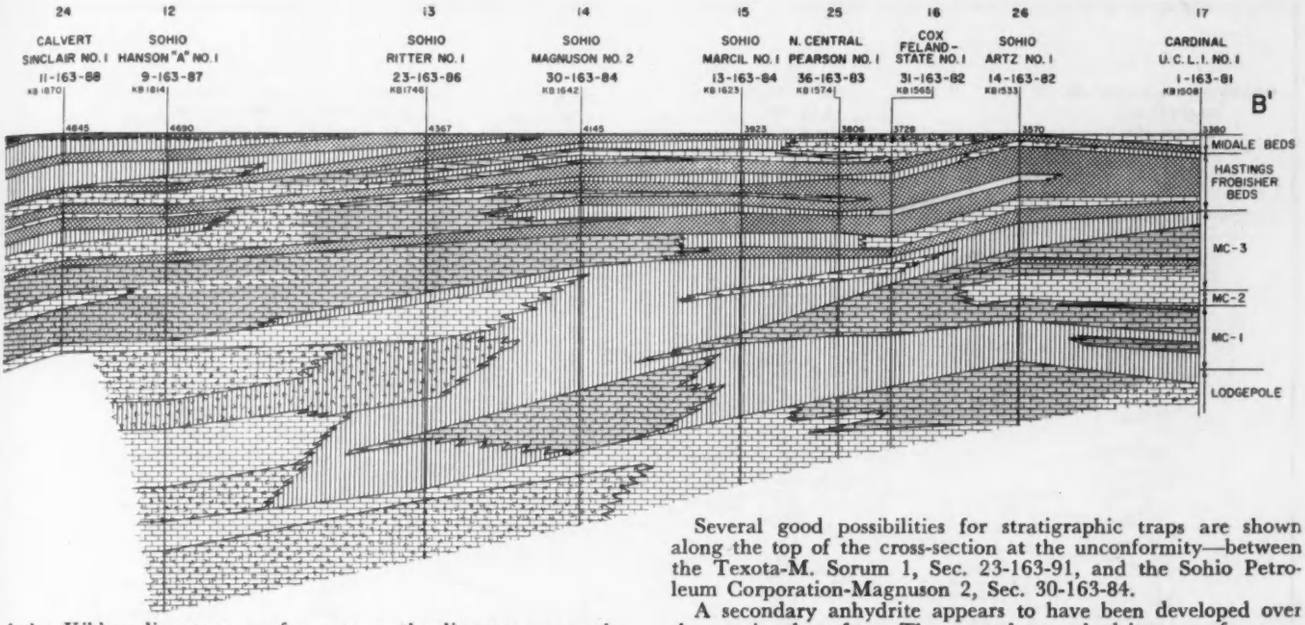


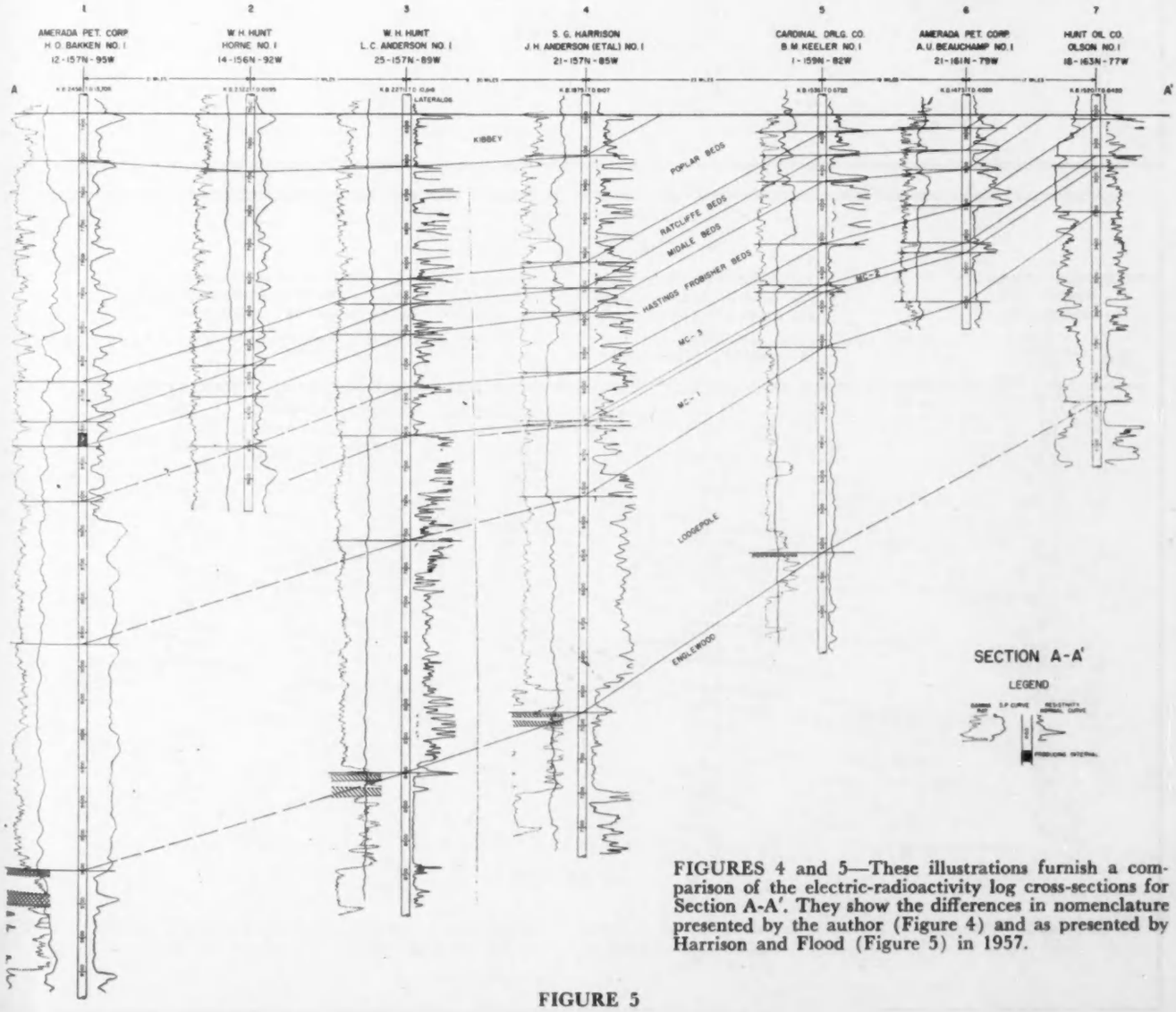
FIGURE 4



of the Kibbey limestone as far east as the limestone extends, and from that point eastward the post-Mississippian unconformity is used for a datum.

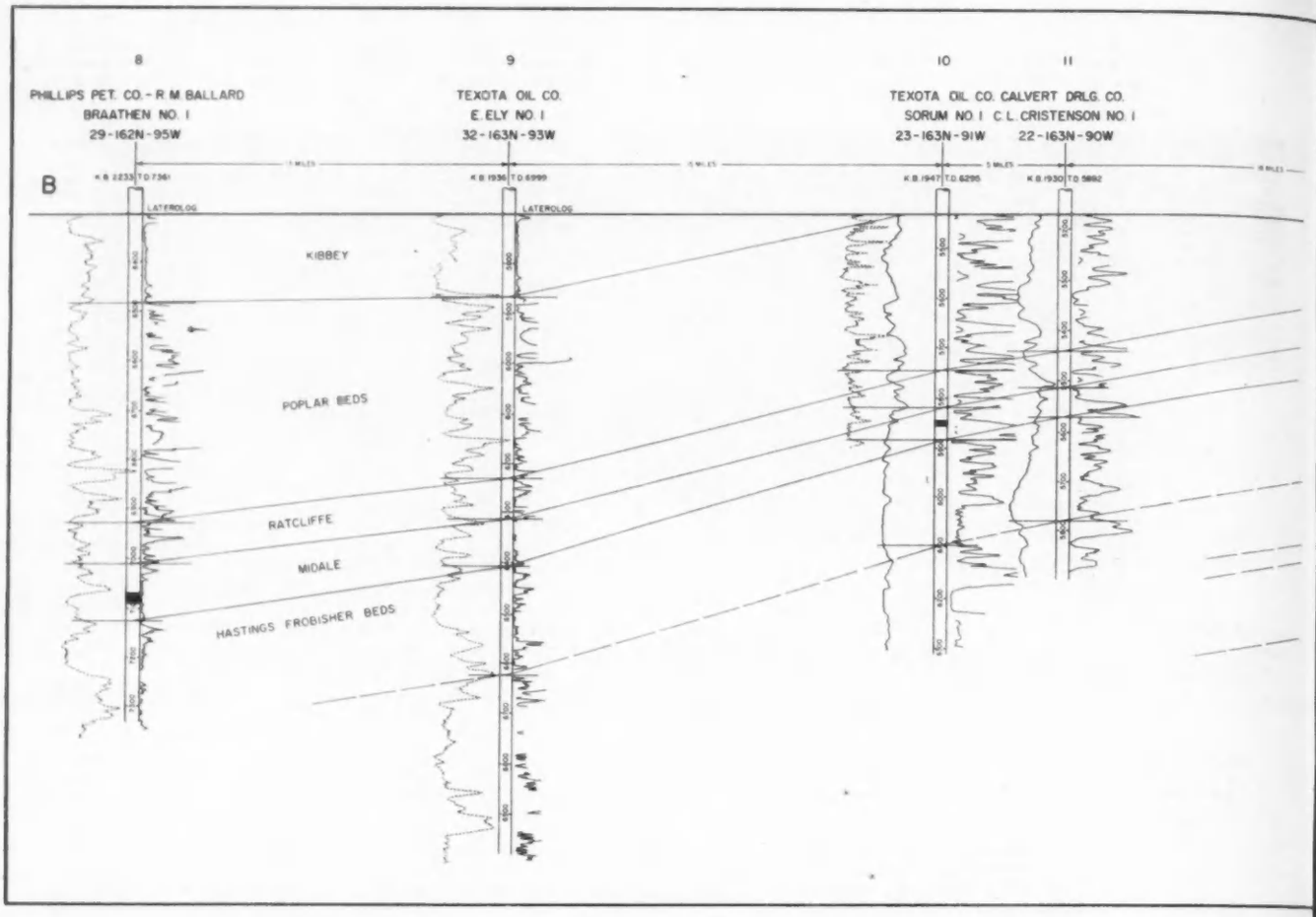
Several good possibilities for stratigraphic traps are shown along the top of the cross-section at the unconformity—between the Texota-M. Sorum 1, Sec. 23-163-91, and the Sohio Petroleum Corporation-Magnuson 2, Sec. 30-163-84.

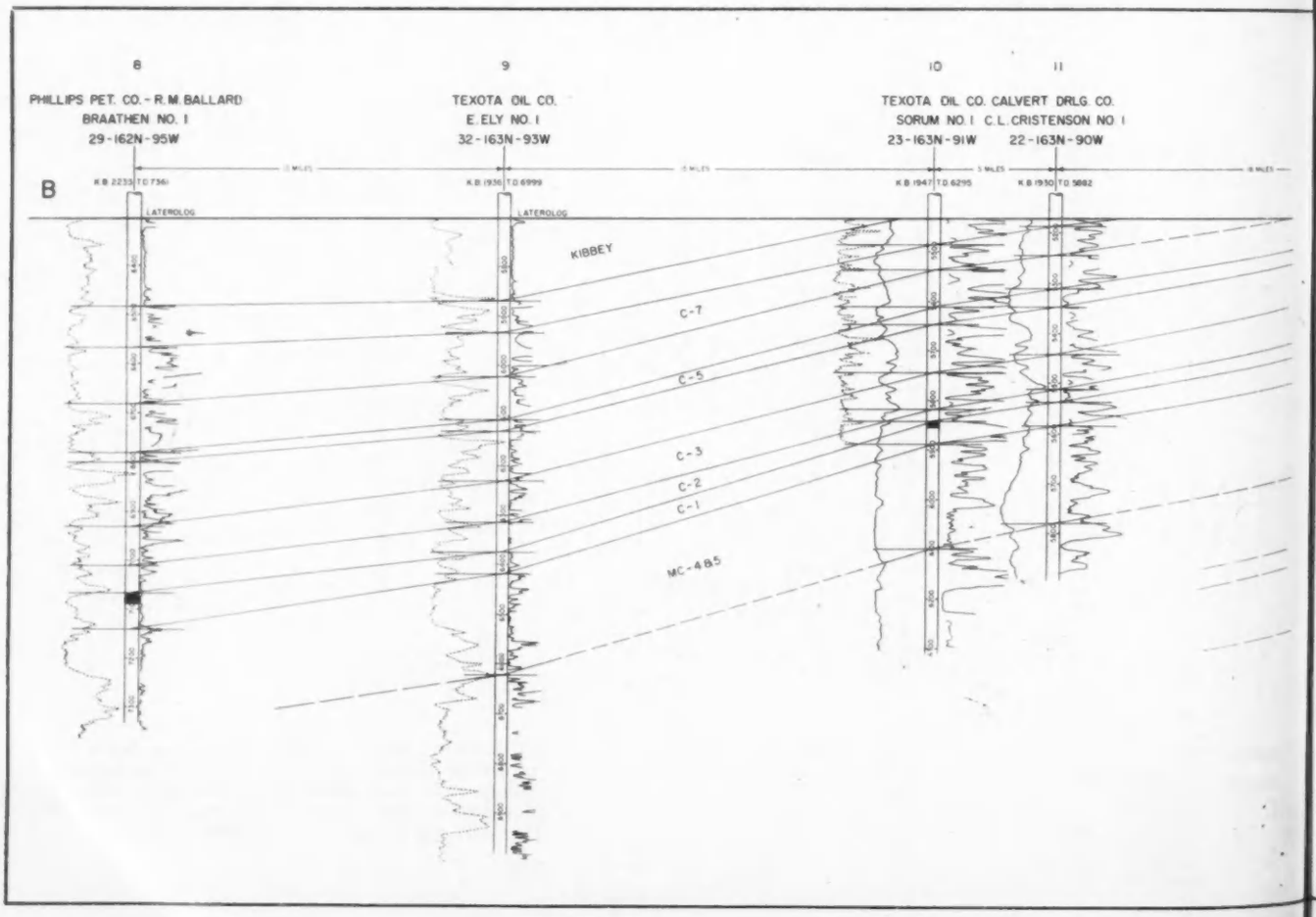
A secondary anhydrite appears to have been developed over the erosional surface. The secondary anhydrite may form an effective seal over the truncated limestone beds which could create excellent stratigraphic traps.



FIGURES 4 and 5—These illustrations furnish a comparison of the electric-radioactivity log cross-sections for Section A-A'. They show the differences in nomenclature presented by the author (Figure 4) and as presented by Harrison and Flood (Figure 5) in 1957.

FIGURE 5


8
9
10
11
PHILLIPS PET. CO. - R.M. BALLARD
BRAATHEN NO. 1
29-162N-95W
TEXOTA OIL CO.
E. ELY NO. 1
32-163N-93W
TEXOTA OIL CO. CALVERT DRLG. CO.
SORUM NO. 1
23-163N-91W
C.L. CRISTENSON NO. 1
22-163N-90W
B
LATEROLOG
KIBBEY
POPLAR BEDS
RATCLIFFE
MIDALE
HASTINGS FROBISHER BEDS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PHILLIPS PET. CO. - R.M. BALLARD
BRAATHEN NO. 1
29-162N-95W
TEXOTA OIL CO.
E. ELY NO. 1
32-163N-93W
TEXOTA OIL CO. CALVERT DRLG. CO.
SORUM NO. 1
23-163N-91W
C.L. CRISTENSON NO. 1
22-163N-90W
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C-7
C-5
C-3
C-2
C-1
MC-4&5

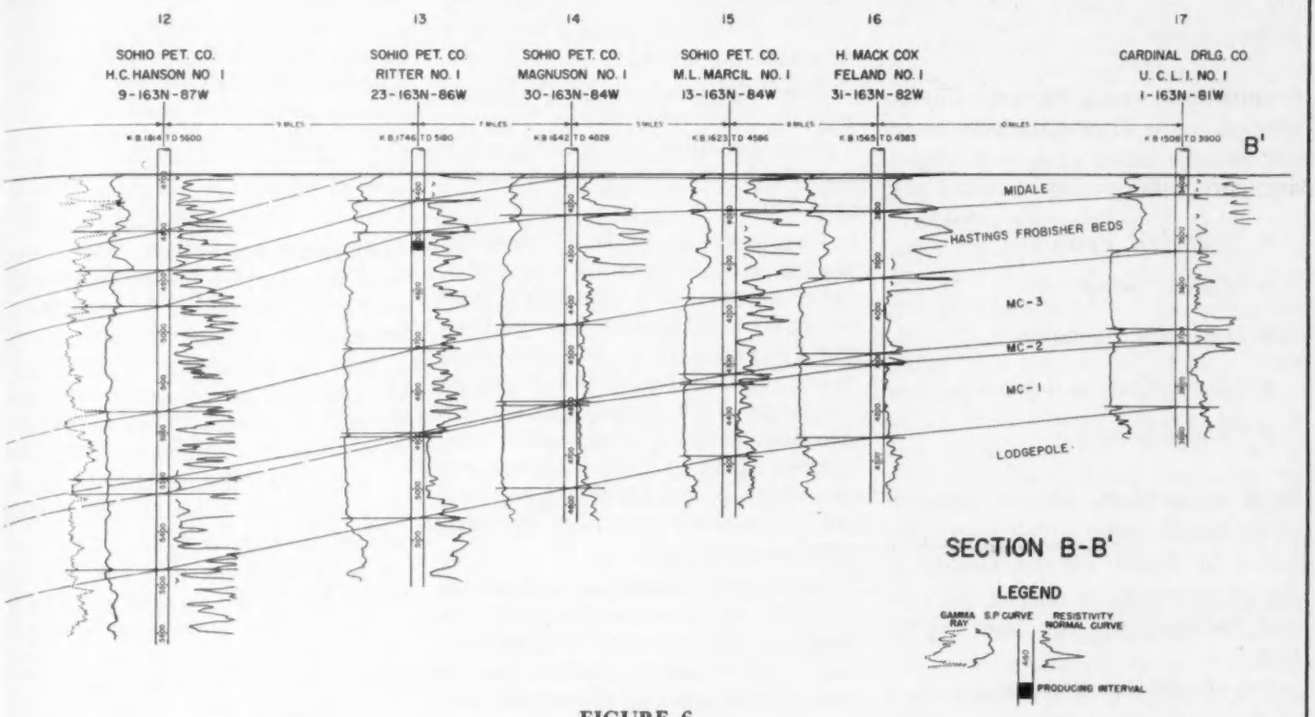

FIGURE 6

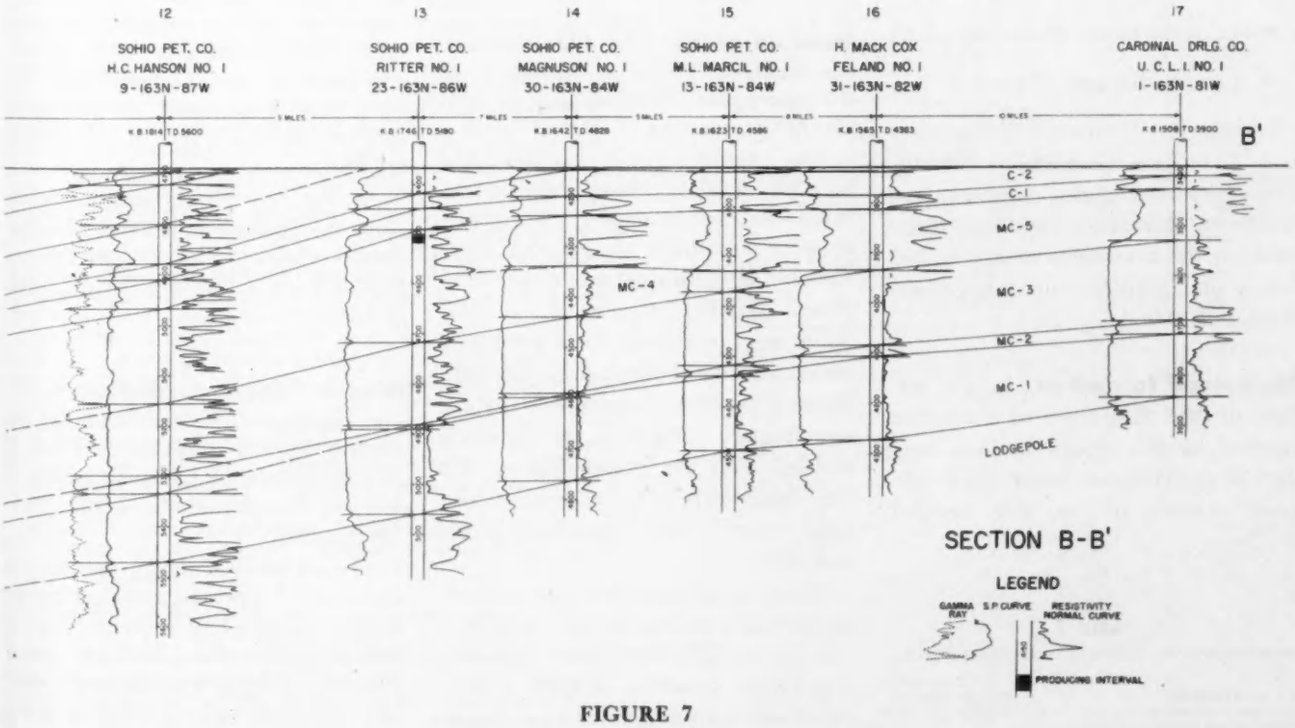

FIGURE 7

FIGURES 6 and 7—These illustrations compare electric-radioactivity log cross-sections for Section B-B'. They show the differences in nomenclature as presented by the author (Figure 4) and as presented by Harrison and Flood (Figure 6) in 1957.

much more difficult to find, and finding them will require detailed subsurface studies.

Formations considered. Facies changes in the Upper Madison group discussed lie under an area as shown in Figure 1. Formations included are:

- Englewood formation
- Madison group
- Lodgepole formation
- Mission Canyon formation
- Charles formation

Data selection. Control data include sample logs, which were prepared by North Dakota Geological Survey geologists, as well as electrical and radio-activity logs from NDGS files.

For clarification of correlation work of the Mississippian series, the following illustrations have been included:

- Two geologic cross-sections (Figures 2 and 3)
- Four electric and radioactivity log cross-sections (Figures 4, 5, 6, and 7)
- A nomenclature chart (Figure 8)
- A facies diagram (Figure 9)

Lithologies illustrated in Figures 1 and 2 include limestone, dolomite, salt, anhydrite, shales, siltstone and sandstone. Limestone textural terms used on the cross-sections are oolitic, fragmental, granular and dense, as defined in Table 1.

Englewood formation. In the portion of the Englewood formation covered by this report, as in a large part of the Williston Basin, the Englewood consists of two thin bedded, carbonaceous, hard, dark gray to black shales, separated by a light gray siltstone, very fine grained sandstone or a thin limestone.

TABLE 1

Constituents	Type of Limestone
Spherical or subspherical grains without regard to internal structure....	Oolitic
Aggregates of fossil or rock fragments	Fragmental
Non-interlocking crystals with few rock or fossil fragments.....	Granular
Interlocking crystals—virtually no porosity.....	Dense

The Englewood in North Dakota rests unconformably on the Devonian Lyleton formation and is conformably overlain by the Mississippian Lodgepole formation.

From outcrops in the Black Hills,[7] Darton in 1901 described outcrops as being composed of a pink slabby limestone, 20 to 30 feet thick, underlying the Pahasapa limestone and overlying the Cambrian Deadwood formation. Later, the formation was described as being composed of varicolored shales with intercalated beds of reddish brown limestone and buff colored dolomite underlying the Pahasapa limestone.[4]

From samples obtained in Amerada Petroleum Corporation's H. O. Bakken 1, Sec. 12-157-95,[11] the black shale and sandstone at the base of the Mississippian in North Dakota was named the Bakken formation. However, in the opinion of the NDGS, the Englewood of North Dakota correlates reasonably closely with the Englewood of the Black Hills. Therefore, there is no apparent need to use the term "Bakken," unless further study indicates the need.

Madison group. The NDGS defines the Madison group as consisting of the Lodgepole, Mission Canyon and Charles formations.

The Madison group was described in 1893 by Peale, who divided it into three units: laminated limestones, massive limestones and jaspery limestones.[12] He described laminated limestones as dark, fine-grained, compact limestones occurring in laminated beds; massive limestones as light bluish-gray and massively bedded; and jaspery limestones as massively bedded with the upper 300 or 400 feet being generally yellowish white, light colored beds containing jasper and chert.

These formations are time-honored terms which still have some validity in parts of the Williston Basin. However, the facies situation is such that if lithologies only are used, these formations would intergrade with each other, particularly the Mission Canyon and Charles.

The Bakken was included in the Madison group by Fuller (1956), who placed the Lodgepole and Mission Canyon formations in a unit termed Madison limestone.[8] Considerable confusion has existed in the nomenclature in this part of the geologic column, as can be seen in Figure 8.

Lodgepole formation. This formation was named for exposures in Lodgepole Canyon in the Little Rocky Mountains of Eastern Montana by Collier and Cathcart (1922),[6] who described it as consisting of fossiliferous thin-bedded limestones and shales having a thickness of 800 feet.

Texture of the Lodgepole in the portion of the Williston Basin under discussion varies from fine-grained dense to granular and fragmental limestone. There appears to be more granular and fragmental limestone toward the eastern part of the area. The lower part of the Lodgepole often is argillaceous with a cherty limestone section immediately underlying it. The color varies from medium gray to light gray becoming pale reddish to pale orange toward the edge of the basin.

In the section of North Dakota covered by this report, the Lodgepole conformably overlies the Englewood formation, and is conformably overlain by the Mission Canyon formation. Thickness of the Lodgepole in this area varies from about 560 feet in the east to about 650 feet on the Nesson anticline.

As yet, no production has come from the Lodgepole in North Dakota. However, the formation does produce in the Lulu Lake and Virden areas of Manitoba.

Mission Canyon formation. Collier and Cathcart (1922) named this formation for exposures of 500 feet of massively bedded white limestone in Mission Canyon in the Little Rocky Mountains.[6]

The Mission Canyon, in the east and central portions covered by this report, consists largely of pale red to pale orange oolitic and fragmental limestone having a thickness of about 280 feet, grading into yellow gray and yellow brown fine grained, dense limestone about 650 feet thick in the west part.

The Mission Canyon contains sev-

eral excellent zones of porosity, particularly in the central and eastern portion, where the formation becomes largely oolitic [see Anderson and Nelson (1956) and Figures 1 and 2].[3] In the east part, Mission Canyon contains an anhydrite bed which has been called the Middle Anhydrite by Anderson and Nelson. Others have termed this the M. C. 2 bed (Figure 8), which points to the fact that it is an excellent marker bed. This marker bed ranges from about 10 to 30 feet in thickness and occurs in about the center of the formation. To the west, this anhydrite marker becomes shaly or dolomitic and eventually changes to limestone.

The Mission Canyon rests conformably on the Lodgepole formation, and is overlain conformably by the Mississippian Charles formation, although the typical Charles lithology in the east appears in part to be the time equivalent of the Mission Canyon lithology in the west.

In the eastermost part of the area of this report, the Charles has been eroded and the Spearfish red beds overlie the Mission Canyon unconformably.

Charles formation. Seager (1942) named the Charles formation from the Arro Oil and California Company's 4, SE NW 21-15N-30E, Garfield County, Montana.[14] He described the Charles as a sequence of anhydrite, limestone, brown to red shales, siltstones, and dolomite lying between the Kibbey and Mission Canyon limestone. Seager placed the Charles in the Big Snowy group, but did not designate the interval; however, Nordquist (1953)[11] put the Charles in the Madison group and designated the interval in the type well as being from 3,195 to 3,800 feet. Anderson (1954)[1] also put the Charles in the Madison group. Thickness of the Charles is governed both by regional thinning eastward and pre-Mesozoic erosion.

In the western section of the area under discussion, the Charles consists largely of salt, anhydrite and limestone. In the east part, it consists largely of anhydrite and limestone with only one minor salt which is stratigraphically lower than the salts to the west as shown on Figure 1. Massive salt beds in the west part thin to the east and eventually are replaced by anhydrite.

The limestone of the Charles grades from a pale brown and light gray in the west to a yellowish gray in the east part of the area. The anhydrites vary from a light gray and bluish white to a pale red, becoming more reddish to the east. The formation varies in thickness from about 820 feet in the Amerada H. O. Bakken 1, 12-157-95, to being absent in the east part of the report area, where the formation has been removed by erosion.

From present studies, the contact between the Charles and Mission Canyon apparently is conformable and transitional, and, in part, the two formations are time equivalents. In this area, the Charles is overlain un-

ANDERSON & NELSON 1956	HARRISON & FLOOD 1957	J.G.C.M. FULLER 1956	SASK. GEOL. SOCIETY 1956	TERMINOLOGY THIS REPORT
CHARLES	C-8	CHARLES EVAPORITES	POPLAR BEDS	POPLAR BEDS
	C-7			
	C-6			
	C-5			
	C-4			
	C-3	RATCLIFFE BEDS	RATCLIFFE BEDS	RATCLIFFE BEDS
	C-2	MIDALE EVAP. / MIDALE BEDS	MIDALE BEDS	MIDALE BEDS
	C-1	FROBISHER EVAP.		
	MC-5	HASTINGS FROBISHER BEDS	FROBISHER ALIDA BEDS	HASTINGS FROBISHER BEDS
	MC-4			
UPPER MISSION CANYON	MC-3	L.S. FORGET NOTTINGHAM LIMESTONE		MC-3
MIDDLE ANHY.	MC-2	UP. MAD. MC-2	TILSTON BEDS	MC-2
LOWER MISSION CANYON	MC-1	MC-1		MC-1
LODGEPOLE	LODGEPOLE	LOWER MADISON LIMESTONE	SOURIS VALLEY BEDS	LODGEPOLE
ENGLEWOOD	BAKKEN	BAKKEN	BAKKEN	ENGLEWOOD

FIGURE 8—Four of the various nomenclature systems used to correlate the Mississippian system in the Williston Basin—in addition to the one used in the accompanying report—are shown on this chart. While all the systems have advantages, correlation becomes difficult with many different usages. For clarification, this combined system is used. For comparison with this combined system, Harrison and Flood's terminology appears in Figures 5 and 6.

It appears that the term "Souris Valley Beds" used in the Saskatchewan Geological Society's stratigraphic cross-sections (1956)[12] may be confused with the previously named Devonian Souris River formation. Therefore, the term "Lodgepole" is retained for the sequence below the M. C. 1 (Tilston Beds) and above the Englewood (Bakken). This usage is in line with the original and well-known definition of the Lodgepole formation.

Due to lack of paleontological information, certain marker beds selected from electric and radioactivity logs are used as time lines. The wide regional consistency of electric log characteristics, thickness and dip into the basin of these beds lends credence to this supposition.

The Mission Canyon has been described as massive marine limestone, and the Charles as largely an evaporitic sequence. If these descriptions are followed, it will be noted on the cross sections (Figures 1, 2 and 9) that the base of the Charles is stratigraphically lower towards the east while the top of the Mission Canyon is stratigraphically higher toward the west in the deeper part of the basin. (Similar conditions of integradation appear to exist at the Lodgepole-Mission Canyon contact farther east outside the area of this report.

As a result, such expressions as "Lodgepole formation in Mission Canyon facies," meaning "Mission Canyon formation of Lodgepole age," are used (Moore, 1955)[20].

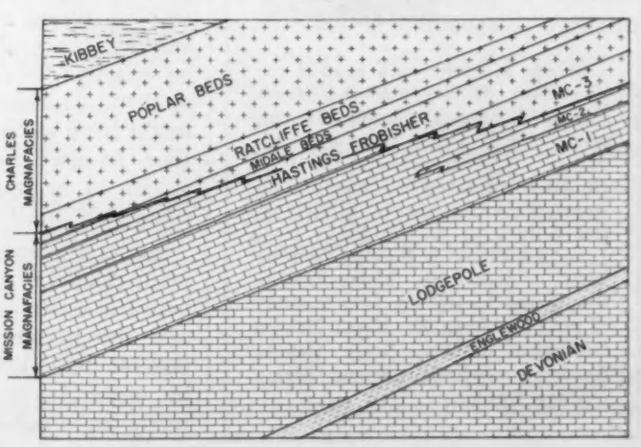

FIGURE 9—On the basis of the descriptions found in Figure 8, "formations" of the Madison group are stripped of their original connotation and become ingrading belts of lithology, which are seen to cross time lines within the Williston Basin. Gross lithologic belts which transgress time (although in a dissimilar tectonic setting) originally were defined by Caster (1934) as magnafacies.[8]

Thus, the massive marine limestone facies of the Williston Basin might be more correctly called the Mission Canyon magnafacies and the evaporitic facies could be termed the Charles magnafacies, divesting these "formations" of the time connotation, which has led to correlation confusion in the Williston Basin.

conformably by the Spearfish of Triassic or Jurassic age.

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How to detect and control corrosion-causing bacteria

Combatting bacterial corrosion requires an understanding of the processes involved and the methods that restrain it. Some aspects of this type corrosion are not completely understood, but these known methods will aid in corrosion control

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CORROSION CAUSED by bacteria by the destruction of protective coating materials, production of corrosive inorganic and organic acids, oxygen differential cells, production of galvanic cells, production of hydrogen sulfide and the oxidation of ferrous iron, can be controlled if a thorough understanding of the ways of corrosion production is gained. There must be an understanding of the results of the chemicals, methods and procedures used to combat the corrosion. In this manner the type of bacterial corrosion can be determined and the proper steps taken to combat the corrosion, without trying one thing and then another. Since the corrosion cannot be exactly determined by any sure method, a number of suspected types might have to be treated at the same time. As can be seen from this, some aspects of bacterial corrosion are incompletely understood.

Bacterial corrosion in nature is normally related to a complex interaction between environmental conditions and the bacterial population. It is possible to describe several processes by which bacteria directly or indirectly cause corrosion.

Oxygen differential cells. The simplest type of corrosion is produced during the growth of a normal aerobic population of bacteria. The area in which bacteria are active has less oxygen than an adjacent area, supporting little or no bacterial activity. The difference in oxygen concentration between the two areas produces an oxygen differential cell. The differential cell persists as long as the bacteria use oxygen faster than new oxygen can diffuse into the area.

Production of acids by bacteria. Organic and inorganic acids are produced during the metabolism of bacteria which may stimulate acid corrosion in localized areas. Several different acids are produced that are related to specific metabolic processes. The oxidation of sulfur compounds by the sulfur bacteria, Thiobacteriales, will produce sulfuric acid. The following reaction illustrates the oxidation of hydrogen sulfide and sulfur:

$$H_2S + \tfrac{1}{2}O_2 \rightarrow S + H_2O$$

$$2S + 3O_2 + 2H_2O \rightarrow 2H_2SO_4$$

Some bacteria are able to produce

H_2SO_4 concentrations up to 1 Normal. The hydrogen sulfide produced by sulfate-reducing bacteria will dissociate in water to a weak acid. Carbon dioxide, a very common metabolic product, is hydrolyzed to carbonic acid in the presence of water. Nitrous and nitric acids also are produced by the metabolism of nitrogen compounds. In addition, the aerobic or anerobic decomposition of organic matter may produce lactic, butyric, acetic and related acids.

Bacterial deterioration of protective coatings. Bacteria can utilize almost all organic compounds during metabolism, and thus are able to cause corrosion indirectly by the destruction of some protective coatings. Bacteria can destroy certain hydrocarbons, asphalts, rubber, fabrics and other coating compounds commonly used for corrosion protection. Usually the bacterial attack is localized in small areas on the protected surface.

Anaerobic corrosion by sulfate-reducing bacteria. The activities of sulfate-reducing bacteria in moist anaerobic soils can cause corrosion by two interrelated methods:

1. The free hydrogen sulfide produced during sulfate reduction may react directly with iron.

2. The bacteria produce a corrosive galvanic cell. (Von Wolzogen Kühr-and Van der Vlugt, 1951.)

Sulfate-reducing bacteria are a group of widely known but little described organisms that are difficult to study. This type of organism is called *Desulfovibrio desulfuricans*. The sulfate-reducing bacteria are found almost everywhere in nature. They can survive in aerobic environments but will grow only in the absence of free oxygen.

The sulfate-reducing bacteria obtain energy through the reaction:

$$2H^+ + SO_4^{--} + 4H_2 \xrightarrow[\text{catalyst}]{\text{bacterial}} H_2S + 4H_2O$$

The bacterial enzyme, hydrogenase, catalyzes the reduction of sulfate by molecular hydrogen. The enzyme, dehydrogenase, catalyzes the reduction of sulfate by hydrogen derived from an organic molecule. Many sulfate-reducing bacteria can use both enzymes at the same time (Senez, 1955).

The action of hydrogen sulfide on iron surfaces will produce corrosion as shown by the following reaction:

$$Fe + H_2S \xrightarrow{H_2O} FeS + H_2$$

The reaction will be accelerated if the compounds on the right side of the equation are removed. In most environmental conditions where bacteria will produce hydrogen sulfide corrosion, the products will not be removed from the system.

The surface of iron or steel in an anaerobic environment will often be negatively charged. The accumulation of a uniform thin layer of hydrogen gas on this negatively charged metal surface will protect the surface from corrosion. If hydrogen is removed from the iron surface by bacteria, the area is no longer protected and a galvanic cell may be produced as follows:

A galvanic cell produced by hydrogen consuming sulfate-reducing bacteria

SO_4 Red. Bacteria Present

$$2H^+ + SO_4^{--} + 4H_2 \rightarrow H_2S + 4H_2O$$

$$Fe^{++} + H_2S \rightarrow FeS + 2H^+$$

$$Fe \rightarrow Fe^{++} + 2e^-$$

ANODE

SO_4 Red. Bacteria Absent

$$2H_2O \rightleftarrows 2H^+ + 2OH^-$$

$$2H^+ + 2e^- \rightarrow H_2$$

CATHODE

IRON OR STEEL PIPE

The bacteria consume the hydrogen from the iron surface to complete the energy reaction:

$$2H^+ + SO_4^{--} + 4H_2 \rightarrow H_2S + 4H_2O$$

The iron surface, denuded of hydrogen, becomes the anode. The iron goes into solution as ferrous ions and electrons are liberated according to the anodic reaction:

$$Fe \rightarrow Fe^{++} + 2e^-$$

The electrons from the anode reaction migrate to the cathode were they are accepted by the hydrogen ions to form hydrogen gas.

$$2H^+ + 2e^- \rightarrow H_2$$

The ferrous ions react with hydrogen sulfide to produce hydrogen ions and insoluble iron sulfide. The liberated hydrogen ions may migrate to the cathode or react with the available hydroxyl ions to form water. Iron sulfide precipitate on the anodic iron surface will act as a cathode and thus accelerate the liberation of ferrous ions. Iron hydroxides may also develop in this system. The equilibrium relationship thought to exist between ferrous sulfide and ferrous hydroxide is shown as follows:

$$FeS + OH^- + H_2O \rightleftarrows Fe(OH)_2 + HS^-$$

If carbon dioxide exists in the system, iron carbonate may form. Ferrous sulfide in the presence of weak carbonic acid will form an equilibrium with ferrous carbonate:

$$FeS + H_2CO_3 \rightleftarrows FeCO_3 + H_2S$$

The most important hydrogen-consuming bacteria in anaerobic environments are the sulfate-reducing bacteria. However, many other types of bacteria can consume hydrogen in both aerobic and anaerobic conditions.

A survey of the literature on anaerobic corrosion may give the impression that all sulfate-reducing bacteria cause equal amounts of corrosion. It is true that all sulfate-reducing bacteria cause corrosion, but the amount varies with the type of bacteria involved. The amount of corrosion caused in hydrogen sulfide systems is much less than in a galvanic cell. Sulfate-reducing bacteria produce galvanic corrosion cells only if they contain the enzyme hydrogenase. Hydrogenase is not present in all sulfate-reducing bacteria (Stephenson, 1957 and Pratt, 1951).

Corrosion by iron bacteria. The iron bacteria are a group of organisms which live in oxygenated, iron-bearing water. They cause corrosion by oxidizing ferrous iron. The group consists of the *Leptothrix, Crenothrix, Sphaerotilis*, and *Clonothrix*. These organisms extract iron from the water and oxidize it to ferric hydroxide according to the reaction:

$$4FeCO_3 + O_2 + 6H_2O \rightarrow 4Fe(OH)_3 + 4CO_2$$

Iron bacteria obtain energy either by the oxidation of iron or the decom-

position of organic matter. The bacterial oxidation of iron produces only small amounts of energy, the therefore large amounts of iron are precipitated during the formation of cellular material. The bacteria deposit iron hydroxide in an outer sheath surrounding individual cells or groups of cells and long threads or spiral aggregates are formed. Much of the yellow-red material seen in many rivers or ponds may be produced by iron bacteria.

Tubercles of iron hydroxide are formed on the surface of iron during the metabolic activities of the iron bacteria. The tubercles rapidly increase in size as the bacteria grow and soon form a dense coating on the iron surface. The oxygen needed for bacterial growth must diffuse through the iron hydroxide coating. As the coating increases in thickness, the rate at which the oxygen diffuses to the bacteria is decreased. The bacteria consume the oxygen faster than the oxygen diffuses into the tubercle and an oxygen differential cell is formed. The resulting anaerobic conditions then allow sulfate reducers or other anaerobic bacteria to grow. Soluble ferrous ions will diffuse out of the anaerobic tubercle and will be available to the iron-oxidizing bacteria on the tubercle surface. The tubercles grow very quickly in a pipe system containing water and in a few weeks may completely block the flow of water.

The iron bacteria grow best in waters of neutral or slightly acid pH, and can use iron in concentrations as low as one part per million. Olsen and Szybalski (1950) give a very good summary of the corrosive activities of the iron bacteria.

METHODS OF DETECTING BACTERIAL CORROSION

No reliable method is known which will measure the corrosive effects of bacteria in situ. Generally, bacterial corrosion of iron is determined by an indirect method in which the total number of bacteria are determined and compared with a detailed examination of the corroded area. The well casing potential profile method, which measures the positive or negative potential at ten-foot intervals along the surface of iron pipe, will not detect the localized corrosion areas produced by bacterial activities.

Bacterial corrosion can be evaluated by laboratory methods. In laboratory studies bacteria are isolated from a corroded area and inoculated into a test medium containing electrodes or a piece of iron. After the bacteria have been allowed to grow, the loss in weight or the change in potential of iron test panel is measured. The results are used to evaluate the amount of corrosion caused by the bacterial cultures. Caldwell and Lytle (1953) measured the corrosion of iron test panels in active bacterial cultures. They reported that the corrosion rate due to bacterial action is low. Unfortunately the authors did not report how many different types of purified sulfate-reducing bacteria were tested, and it is possible that the bacteria studied did not contain the enzyme hydrogenase. Pratt (1950) reported data for bacterial corrosion obtained by the weight-loss method, and concluded that the test organism did produce appreciable amounts of corrosion. Wormwell and Farrer (1952) conducted electrochemical studies on the bacterial anaerobic corrosion of iron test panels. The desulfovibrio strain they used produced a more negative electrode potential and caused more corrosion than sterile controls.

The API Subcommittee on Bacteria and Bactericides (Study Committee on Water Treatment) is developing standard methods to determine the bacterial populations in water-flood operations for secondary recovery of oil. However, no provisions have yet been made by the subcommittee to relate bacterial population to corrosion.

More fundamental research is needed before the role of bacteria in corrosion is completely understood. The role of enzymes important to corrosion should be studied. Studies should be made to determine the kinds of bacteria that cause corrosion. Field descriptions and counts of bacteria from a corroded area indicate only that the bacteria are present. Bacteria are everywhere in nature. Therefore, it is important to be able to establish whether or not the bacteria present actually can cause corrosion.

Control of bacterial corrosion

Living organisms must be active before they can cause corrosion. The organisms must be in a favorable environment or they will not be active. The biological relationships between the bacteria and the environment must be understood before adequate corrosion control can be obtained.

The first action to prevent bacterial corrosion should be taken before iron or steel equipment is installed. The type of control to be used will be influenced by environmental conditions such as water content or soil drainage, presence of water spray, amount of electrolytes, presence of organic matter, acidity or alkalinity and oxygen content. Bacterial corrosion can be controlled in certain situations by the application of protective coatings, the use of cathodic protection and the application of chemical biocides to kill living bacteria.

Bacterial corrosion will be at a minimum in a well-drained alkaline soil containing a minimum of electrolytes and organic material. The selection of a resistant coating material and the installation of cathodic protection would be advantageous. If a corrosive environment cannot be avoided, the use of a suitable chemical bactericide corrosion-inhibitor may be used. A bactericide is any material that will inhibit the growth of bacteria or kill them.

Chemical bactericides. Many chemicals and chemical mixtures are currently available which are used to control bacteria in water, petroleum and drilling muds. They are primarily chlorinated phenols, quarternary ammonium compounds, amines and surface active agents. Other materials such as chlorine and formaldehyde are often used. Caustic compounds may be used in such materials as drilling muds to bring the pH to 10 or above to inhibit the growth of the sulfate-reducing bacteria.

Most chemical bactericides are specific for a given type of bacteria and environment. Each inhibitor should be tested against the normal bacterial flora present in the corroded area. The tests should be performed in the mud, soil or water in which the bacteria are growing. Proper bacteriological techniques must be used or contaminating bacteria may be introduced in the sample. If proper care is not taken, the more active organisms will multiply during sample collection or transport and thus overgrow the bacteria responsible for the original corrosive conditions.

Cathodic Protection. Cathodic protection is currently being used to combat the bacterial corrosion of iron used in marine equipment and pipes. Unfortunately, the data published on the use of cathodic protection to control bacterial corrosion, have been taken from field observations. Most of the references give no conclusive data, other than the enumeration of bacteria, to prove that the bacteria were responsible for the corrosion. Beckwith (1940) tested the effects of cathodic protection on sulfate-reducing bacteria. He found that the growth of bacteria was not inhibited during the tests. Huddleston (1947) reported that bacterial corrosion of subsurface pipe lines in a swampy area was reduced by cathodic protection. Huddleston, however, did not conduct laboratory tests to determine if the bacteria were actually causing corrosion. Wormwell, Nurse and Ison (1952) reported that more cathodic current is required to protect iron from bacterial galvanic corrosion than is needed to control other types of galvanic cell corrosion. Caldwell and Lytle (1953) reported that cathodic protection will protect iron from bacterial corrosion.

In theory, the action of cathodic protection will inhibit bacterial corrosion by two processes: (1) the proper amount of cathodic current supplied to the iron surface will attract hydrogen ions and produce free hydrogen faster than it can be used by the bacteria. The hydrogen will protect the iron surface from corrosion, and (2) the cathodically protected surface will produce an excess of hydroxyl ions, and the pH of the area will increase. Bacteria will not be active when the pH is above nine or ten.

Protection by coating materials. Certain bituminous and plastic coating materials are available which can protect the surfaces of iron from bacterial attack. A pipe coating compound should be tested with the bacteria isolated from the soil in which the pipe is to be installed. One disadvantage of this type of protection is that the coating may not completely cover the iron surface. Small areas of the iron, not covered during the coating process or where the coating was removed by damage during installation, may be unprotected. However, special coatings plus cathodic protection may prove complementary and may provide good corrosion protection. The new synthetic plastic coating materials, or plastic pipe, are usually quite resistant to bacterial attack.

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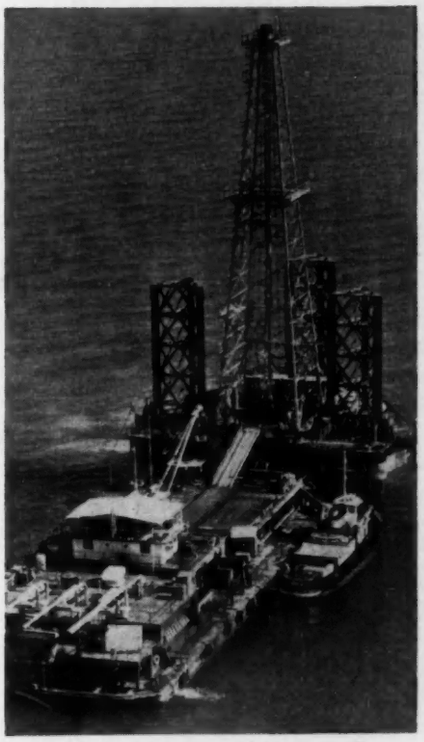


Aerial view of Aramco's mobile platform No. 1 (background) and drilling barge Queen Mary (foreground), drilling Manifa 2 in the Persian Gulf, off the coast of Saudi Arabia. The platform is elevated 10 feet above the water. Manifa 2 is 4½ miles southeast of Manifa 1, which late in 1957 resulted in Aramco's second offshore oil discovery.

Mobile Drilling Platform Employed in Persian Gulf

A new, modern, mobile drilling platform and a drilling barge were used by Arabian American Oil Company in drilling Manifa 2 in the Persian Gulf off the coast of Saudi Arabia. Manifa 2 is 4½ miles southeast of Manifa 1, which in 1957 discovered Aramco's second offshore field.

In the background is Aramco's mobile platform No. 1. It is elevated 10 feet above the water. The three-legged platform supports a standard 136 foot drilling derrick, drawworks, rotary table, and electric motors supplying power. It weighs 800 tons, exclusive of drilling equipment, and can operate in water up to 65 feet deep. The $1 million platform was made in the U. S. and was towed 10,000 miles in 115 days to this site, across the Atlantic and via the Suez Canal.

The platform is connected by a ramp to Aramco's drilling barge, Queen Mary, in the foreground. The barge carries the mud pumps, driven by a diesel-electric power plant, and provides storage for mud, fuel, water, drill pipe, and steel casing.

In North Dakota . . .

Deep drilling and extensions may increase potential of Nesson anticline area

Here is a timely, authoritative review of the Williston Basin's outstanding geological structure

By Dois D. Dallas
Consulting Petroleum Engineer
Williston, North Dakota

DRILLING ACTIVITY continues heavy in North Dakota's Nesson Anticline area. In mid-October, there were 22 active locations including 5 wildcats and 17 development wells.

Eight of the wells have been projected to test horizons below the main producing formation, the Madison. However, this new development has not advanced sufficiently to review the practices and problems encountered.

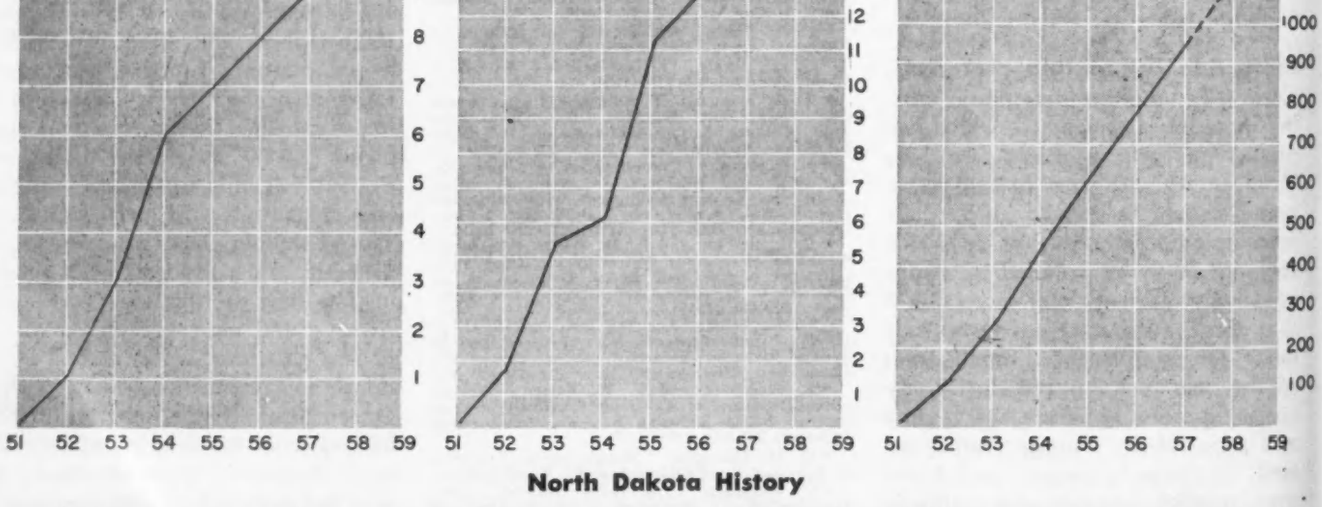
The Nesson Anticline is the outstanding geological feature in the Williston Basin, accounting for most of the area's productive wells. Production is almost continuous along a 75-mile north-south extension of the anticline, and predictions are that production will be found along a 100-mile extension in at least five age groups—Mississippian, Devonian, Silurian, Ordovician and Cambrian.

There are approximately 1,100 producing wells in North Dakota, primarily from rocks of Mississippian age. Depth to the Madison formation varies from about 7,800 feet on the north end of the anticline to about 9,500 feet at the south end.

Drilling program. A typical Madison well is drilled and completed in 30 days. Approximately 30 rock bits are used and a salt-base mud is maintained for the last 3,000 feet of an 8,500-foot well. A 200-foot salt section in the Upper Charles formation and a 50-foot salt section at the base of the Charles have undoubtedly been responsible for numerous collapsed casings. This hazard is reduced by drilling an engaged hole through these and other salt sections.

So meticulous has the operator become about the salt content of the mud, it is not uncommon to see a member of the drilling crew admonished for using fresh water to clean the shale shaker. If the salt content of the mud is maintained at 320,000 ppm or more, there is very little likelihood of dissolving formation salt during the drilling process.

Three common forms of drilling contracts are being used in this area:


Number of Counties Producing Oil
Annual Oil Production, Millions of Bbls.
Number of Wells Producing
51 52 53 54 55 56 57 58 59
North Dakota History

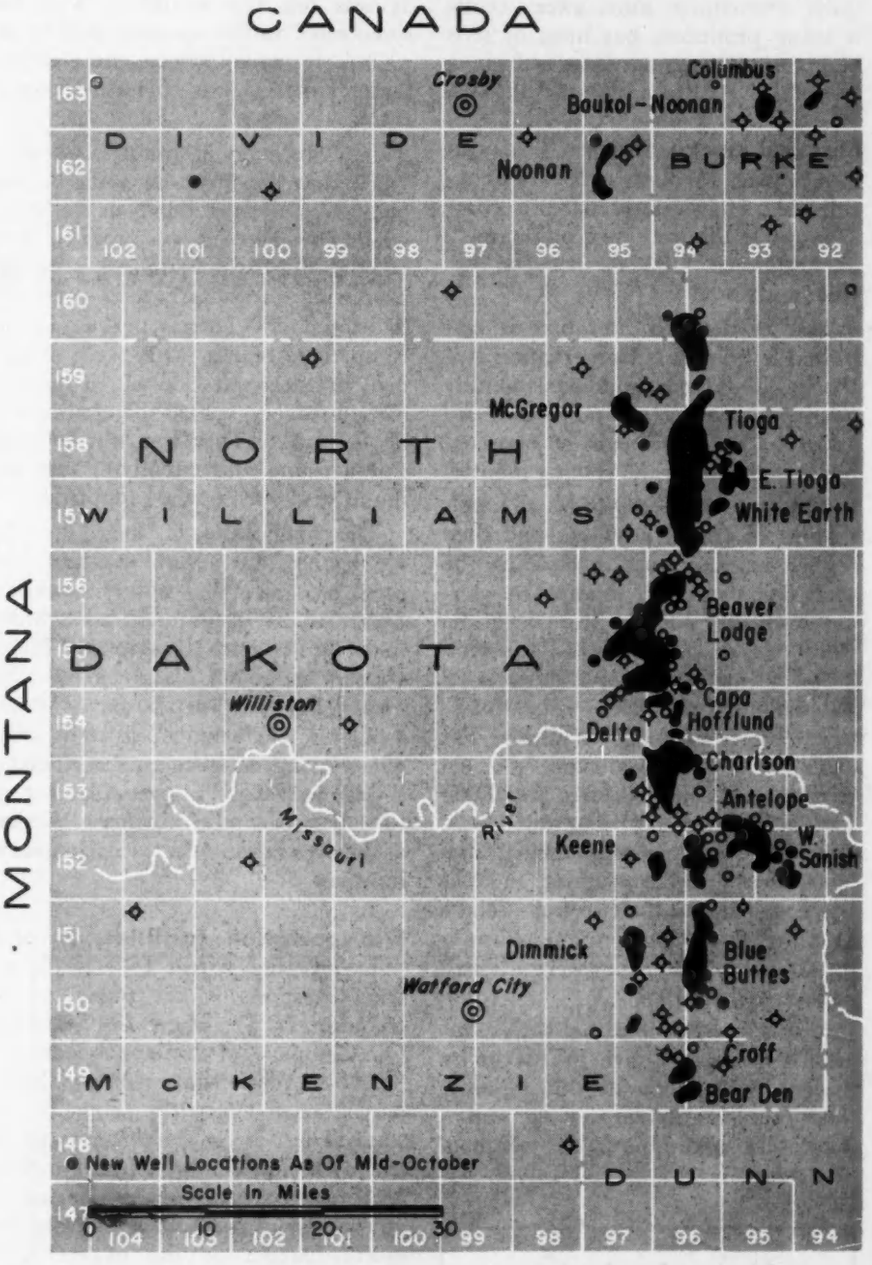
Seven years ago, North Dakota was a non-producing state. Today, it has more than 1,100 wells—produces more than 13 million barrels of crude annually.

- Complete turn-key contracts
- Footage contracts
- Day work contracts

Mud costs vary. Total mud cost is increased considerably with the maintenance of a salt base mud. However, this increased expense is a necessary safety factor and is not considered as a burdensome increase in drilling cost. This cost factor varies from well to well depending upon the proximity of a location to an adequate supply of salt water. Normal mud bills have been known to exceed $10,000, with the average being around $7,500.

Pipe requirements. Casing and tubing programs have become fairly standardized, with operators employing an additional safety factor in weight and grade of pipe, especially through the salt sections. A substantial majority of Madison wells are equipped with 5½-inch casing and 2⅞-inch O.D. tubing. However, some 7-inch casing and 2⅞-inch tubing have been used. Usually, 9⅝-inch O.D. and 10¾-inch O.D. pipe is used for the required 600-foot surface casing string. State law requires that surface pipe be cemented to the surface.

The production string requirement is that sufficient cement be used to fill one and one-half times the calculated volume of the annular space between the casing shoe and the Amsden formation which is above the Charles salt. At least 300 sacks of cement must be used on all jobs. Scratchers and centralizers are used for the section from the Charles to total depth.



Current Activity on Nesson Anticline, Northwestern North Dakota

Types of logs. A typical logging program includes microlaterolog, laterolog, gamma-ray neutron and microcaliper. Usually one log (laterolog) is run for the entire length of the hole, whereas the other logs are used only in the section of interest.

The gamma ray log is a reliable tool for correlation purposes since a characteristic deviation exists at the top of the "main pay" on the Nesson Anticline. The other logs are used extensively for qualitative evaluation of individual wells and entire pools. Comparative porosities and water saturations are often made by using a combination of these logs. The microcaliper readily indicates any appreciable washout in the salt sections.

Completion methods. Practically all Madison (limestone) wells are treated with from 300 to as much as 5,000 gallons of acid or more. When the producing interval is extremely tight, an acid-fracturing program may be considered. In several cases, production has been increased as a result of acid-fracturing. However, in other instances no beneficial results were obtained.

The permanent type completion has been employed by one major company in several wells. However, conventional completions are by far the most common. More than one half of the Madison wells still flow naturally. No unusual pumping problems have been encountered.

Dual completions have been approved by the state and several deep wells, including a few Mississippian wells, have been so completed. Applications for triple completions will undoubtedly be delayed until conservation authorities are satisfied that waste does not exist in dually completed operations.

The Madison crude on the Nesson Anticline is all sour and averages between 41° and 43° API. In the

lower formations some sweet crude is being produced, but most of it is also sour. The gravity varies from a low of 36° API to a high of 53° API.

Cost and market factors. Total cost of a flowing Madison well varies considerably. However, $120,000 is a fair average. If the well must be pumped, an additional $18,000, more or less, will be invested.

Market demand proration is employed by the State Conservation Authority. This body conducts monthly hearings at which all purchasers are asked to file statements of expected crude demand for the coming months.

The State Authority totals all nominations of crude purchases and then follows existing rules in dividing the total demand figure among the various wells and pools in the state. The rules provide for a linear variation between daily allowable and acres assigned to a producing tract. Additional oil is allowed for depth. For example, a well producing from an interval between 8,000 feet and 9,000 feet is granted an allowable three times as great as one producing from 5,000 feet or less, assuming there is equal spacing for the two wells. These rules on allowables were applied on a statewide basis after they were adopted on December 1, 1953.

It was soon realized that such regulations would not give the flexibility desired by some operators in the state. The rules were then revised and a "discovery allowable" rule adopted. It was felt this would at least be some relief to the operator drilling in a remote area where the "depth factor" method was obviously inequitable.

The "discovery allowable" rule provided that the first four wells in any pool (regardless of depth or spacing) would be allowed to produce any amount of oil they were capable of producing (without waste) but not to exceed 200 barrels per day. The completion of the fifth well in the pool or the expiration of 18 months after discovery, voided the application of this rule. This was obviously a stop-gap and subsequently a "marketing district" rule was adopted.

The boundaries of these districts are flexible, but they are so established as to recognize that different market demands exist in different areas when the "depth factor" is applied. There appears to be no disagreement with applying the "depth factor" and "spacing" or "acreage" rules in areas where no variation in market demand is justified. This is particularly true for all except the northern portion of the area covered on the accompanying map.

Transportation facilities. A pipe line gathering system collects the oil and transports it via pipe line to Mandan, N. D., where the Standard Oil Company of Indiana operates a 30,000-barrel-per-day refinery. Mandan is located near the center of the state. There is only one purchaser in this area and the well head price is $3.15 per barrel. Pools in the northern portion and other sections of North Dakota do not as yet have sufficient proven reserves to justify extending the present gathering system or the construction of new systems. Therefore, at the present time, the remainder of North Dakota's oil production is transported by truck and/or rail to markets inside and outside the state. The amount of oil so transported is approximately 8,000 barrels per day.

Daily allowable production for Madison wells located on the Nesson Anticline, when converted to barrels per acre per day, amounts to only about one-half barrel. It is generally felt that, on this basis, North Dakota is not receiving its fair share of the national crude market. However, it is also realized that North Dakota is still one of the youngest oil states and that in time it may expect to obtain a more equitable division of the national market.

Spacing pattern may change. The North Dakota State Industrial Commission is the governing body charged with oil and gas conservation in the state. Each pool is "spaced" by the commission on a temporary basis soon after it is discovered. This temporary period, by rule, is not to exceed 18 months; however, in cases of several marginal operations the temporary period is extended. At the conclusion of the temporary period "proper spacing" is set.

The practice has been to set temporary 80-acre spacing. Consequently, all but an insignificant minority of the wells in the state are on 80-acre spacing or larger.

Indications are that future spacing patterns will be on the order of 160 acres per well. Pools to date have proved fairly uniform and interconnected over wide areas; thus efficient drainage of more than 160 acres by each well is certainly within the realm of probability.

Voluntary unitization and/or repressuring programs are encouraged. Two such programs have been initiated for the Beaver Lodge and Tioga pools, the two largest fields producing from the Madison formation. Waterflooding operations recently were approved in the Beaver Lodge field. Amerada Petroleum Corporation, which completed the first successful oil producer in the Williston Basin, has approval to drill water injection wells around the periphery of the field.

To offset costs of the water wells, operators will be permitted to transfer allowables from these wells to others in the field. The agreement under which the unitized field is operated provides that all interests share in revenue from the Beaver Lodge oil, regardless of where it is produced in the field. The order also approved redesignating all wells in the field by number symbols, instead of their familiar lease names.

No history of a conclusive nature is expected to be available on the Beaver Lodge and Tioga repressuring programs for a year or so.—**The End**

About the Author

Dois D. Dallas is a consulting petroleum engineer at Williston, N. D. He was graduated from New Mexico A&M in 1948 with a B.S. degree in mechanical engineer; received a B.A. degree and a M.A. degree in mathematics from Eastern New Mexico University in 1949 and 1950, respectively. Dallas had further advanced work in mathematics and petroleum engineering at the University of Minnesota. In June 1952, he was employed as a field inspector and petroleum engineer for the North Dakota Geological Survey. In 1955, the Nodana Petroleum Corporation employed him as manager of exploration and production. He has been a petroleum-engineering consultant for several companies operating in the Williston Basin.

Viscosity of clay suspensions

By Dr. Norman Street
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Urbane, Ill.

VISCOSITY IS defined as the tangential shearing stress per unit area that will produce unit rate of shear; the unit is the poise and has the dimensions $ML^{-1}T^{-1}$.

Thus

$$F = \eta \, dv/dr \qquad (1)$$

where,

F = shearing stress,
dv/dr = rate of shear or velocity gradient,
η = coefficient of viscosity.

Clay suspensions usually exhibit anomalous or non-Newtonian viscosity; their flow type frequently is assumed to be of the "Bingham," or plastic type.

Bingham, reasoning that plastic flow (Figure 1) could not start until the applied shearing stress exceeded the stress arising from frictional resistance between particles, introduced a friction factor f into equation (1) and obtained,

$$F - f = \eta \, dv/dr \qquad (2)$$

to describe the flow of such suspensions. Bingham and Green[2] first used the term "yield value" to describe the friction factor.

Since a suspension which obeys Bingham's equation gives an intercept on the stress axis and viscosity is measured by the slope of the shearing stress velocity gradient curve, the rate of shear at the time of measurement determines the viscosity value obtained. The total rheological behavior, dependent on the rate of shear, must be measured on an instrument usable at various and known velocity gradients.

If the line fC in Figure 1 is a plot of measurements made on a "plastic" suspension with such an instrument, then the apparent viscosities at B and A vary with the rate of shear since they are proportional to the slopes of OB and OA.

Flow behavior other than "plastic" often is observed. Those that may be obtained with various suspensions are summarized in Figure 2.

Viscosity of clay suspensions. It often is assumed that suspensions of clay minerals behave as "plastic" fluids, i.e., have a definite yield value that must be exceeded before flow can begin. Experimentally, many clay suspensions show some slight shearing however small the shearing stress applied, and there seems to be no true

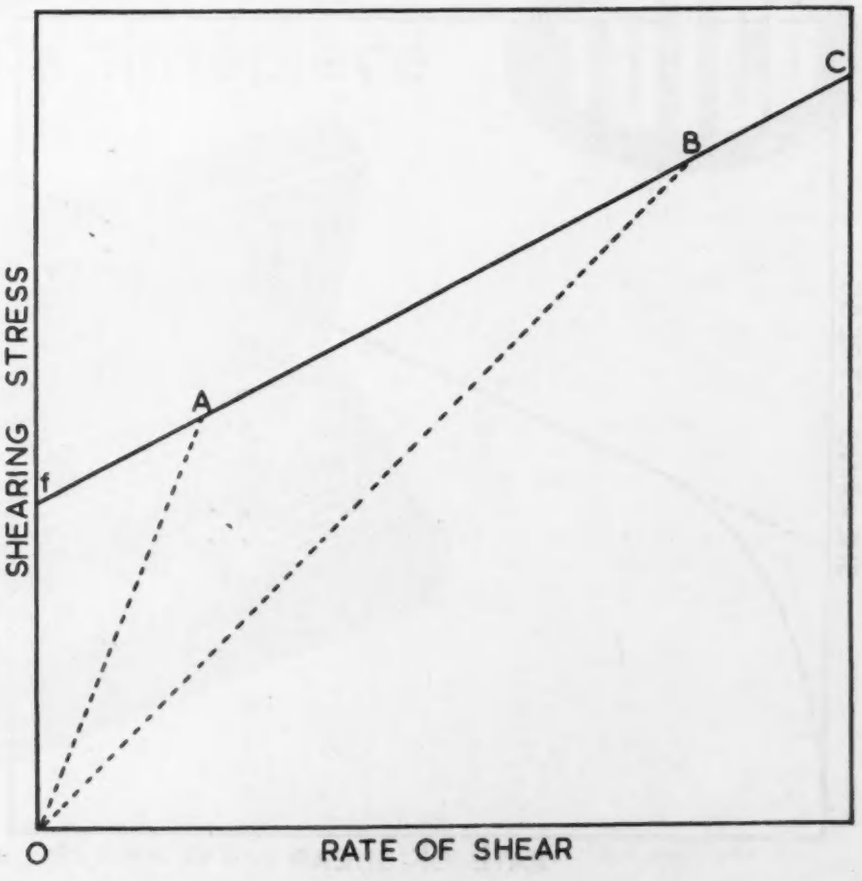

FIGURE 1—The apparent viscosity varies with the rate of shear.

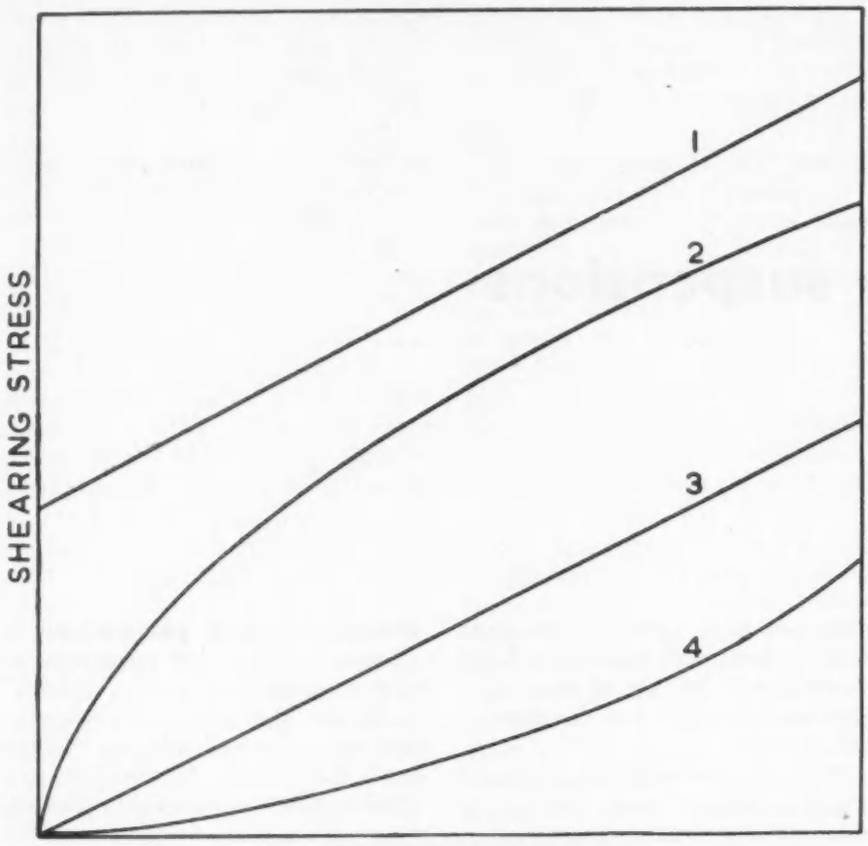

FIGURE 2—Flow behavior other than "plastic" is often observed. They are (1) Plastic (2) Pseudo-plastic (3) Newtonian (4) Dilatant.

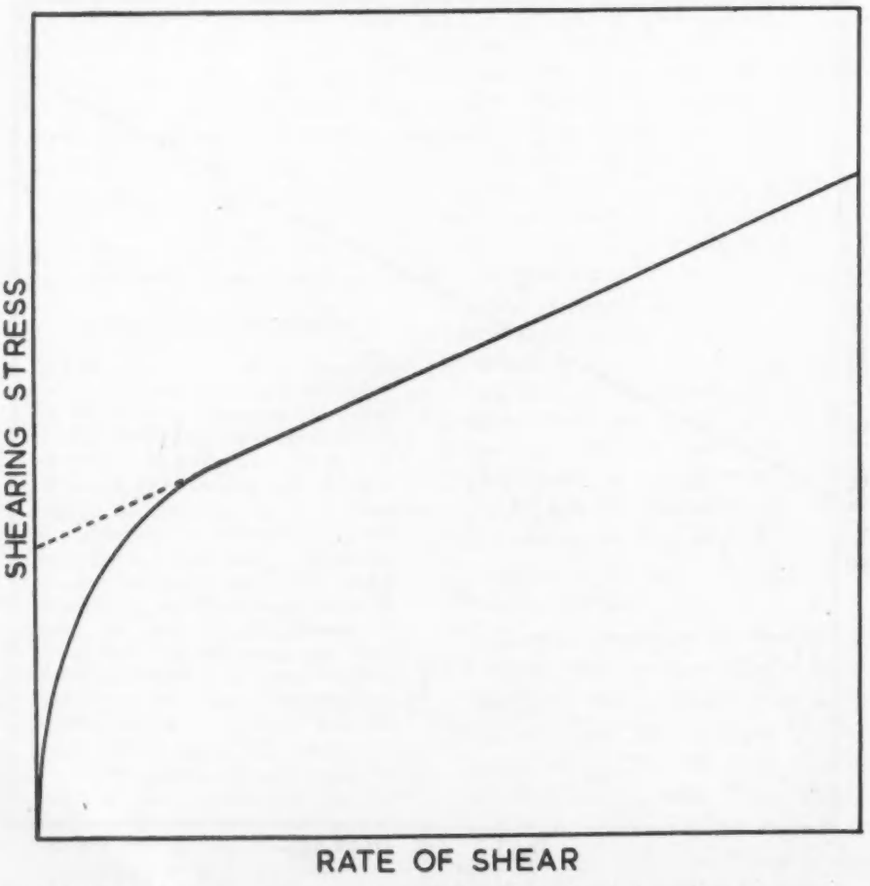

FIGURE 3—The portable flow pattern of clay suspensions follows the above curve.

statically measurable yield value. From this, it seems possible that these suspensions, like macromolecular colloid solutions[3], are better described in terms of a mixture of both "pseudo-plastic" and "plastic" flow.

The true flow curve may be like that shown in Figure 3. The intercept on the stress axis is different from that given by an extension of the assymptote to the stress-velocity gradient curve. The behavior of any one clay may vary at different stages of neutralization of a hydrocarbon clay suspension since (with increasing hydroxyl concentration) the clay is at first flocculated by attraction between oppositely charged areas, then dispersed, and finally flocculated by the operation of van der Waal's attractive forces.

Types of flocculation. Effect of flocculation on viscosity is dependent on the strength of the bonds between the flocculated particles. If these bonds can be broken during shear the measured viscosity will be higher than in the unflocculated system since the bond rupture requires energy. If the bonds are so strong that the suspension cannot be shear deflocculated, the floccules act as individual flow units and the measured apparent viscosity frequently will be lower than in the deflocculated system.

A physical picture that can be used to describe the rheological behavior of clay suspensions is that the hydrogen clay is hetero or bipolar flocculated by the attraction of positive edge and negative face charges[4, 5, 6, 7] (Figure 4a). The replacement of hydrogen ions by ions such as sodium increases the negative face charge. This causes increased repulsion between the negative faces (edge to face attraction still persisting). The result is an extended chain configuration as in Figure 4b. At a pH of approximately 7 for kaolinite and 4.5 for bentonite, or by adsorption of multivalent anions, the positive charge is neutralized and the particles are deflocculated by mutual repulsion of their negative 001 faces.

Further increase in electrolyte concentration causes a decrease in the zeta-potential by compression of the ionic double layer. The particles then

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are flocculated face to face, edge to face, and edge to edge, by the operation of van der Waal's attractive forces as shown in Figure 4c.

It should be noted that it is a reduction of zeta-potential and not necessarily of particle charge that causes the decreased repulsion at high electrolyte concentrations.[4,8] It is possible for the charge to stay constant, or even to increase slightly while the zeta-potential decreases. This is due to the fact that increasing electrolyte concentration will decrease the double layer thickness. This decrease will cause a fall in zeta-potential at constant surface charge density.

Effect of anisometry in clay systems. The yield stress in clay systems has been shown to be proportional to some power of the anisometry of the flow units since particle interaction increases with increasing dissymetry.[9] The increase of dissymetry brought about by chain extension increases the yield stress up to the point of deflocculation. At this point the positive edges are neutralized.

The flow units consist of linked smaller particles capable of extension during shear. This extension proceeds to some extent however low the rate of shear. There is no threshold below which flow will not occur to at least some slight extent. With increasing rate of shear the adlineation and break up of the flow units into less assymetric units gives a reduction in the measured apparent viscosity. The shear dependence of viscosity of the clay suspensions then depends on the length of the flow unit, its extension during shear, and the magnitude of the attraction between its component parts in a manner similar to that summarized for polyelectrolyte solutions.[10]

Thus, it is possible to describe η_a or the apparent viscosity at some specified rate of shear, as a function of $\eta\infty$ or viscosity at infinite shear, and η_o, or viscosity at zero shear. Reiner and Riwlin,[12] starting from Hatscheck's[13] suggestion that the apparent viscosity decreases with increasing rate of shear because of a reduction of solids volume concentration (brought about by the shearing off of lyospheres during flow), showed that an exponential decrease of viscosity occurred in accordance with the following equation.

$$\eta_a = (\eta_o - \eta\infty)\ e^{-c.dv/dr} - \eta\infty \qquad (3)$$

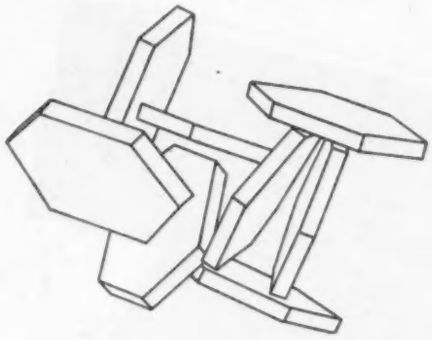

FIGURE 4a—Heterocoagulated clay particles.

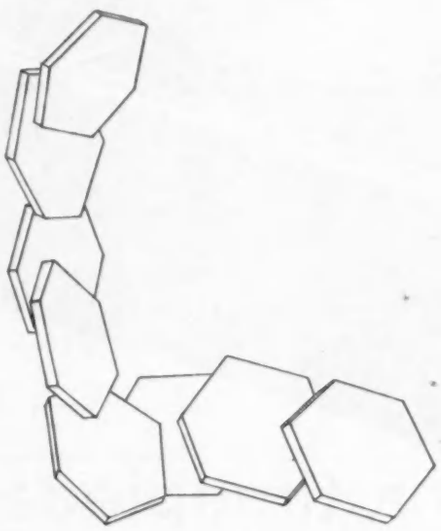

FIGURE 4b—Extended clay chain particles.

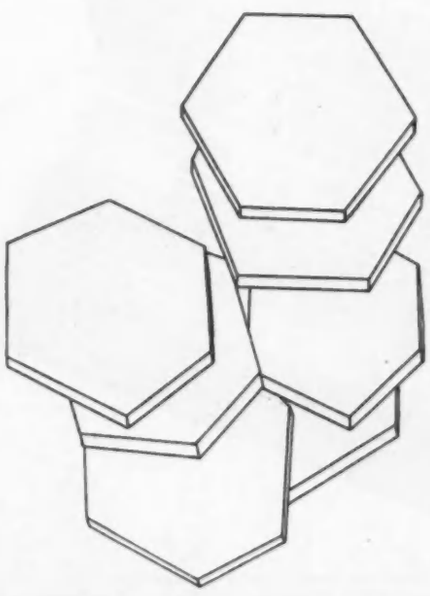

FIGURE 4c—Lamellar flocculated particles.

It is conceivable that the volume decrease and the breakup of floccules in a clay suspension follows a similar law. (To some extent, the volume effective as the volume concentration to be used in the simple Einstein equation $\eta_a = \eta\infty\ (1 + 2.5\theta)$ is that swept out by the anisometric particles during their rotation.) If the suspension follows true Bingham flow then,

$$\eta_a = \eta\infty + \frac{f}{dv/dr} \qquad (4)$$

where f is the yield stress as defined by Bingham or the thixotropic coefficient in the analysis due to Goodeve and Whitfield.[14]

Viscosity of deflocculated suspensions. The rheological behaviour of a clay suspension following neutralization of the positive charges, is controlled by the balance between the van der Waal's attractive and the large electrostatic repulsive forces between dispersed particles.[4] The yield stress drops to zero or becomes very small, dependent in part on the volume concentration of the suspension.[15] This behavior persists until increased electrolyte concentration again decreases the zeta-potential bringing about flocculation of the type depicted in Figure 4c. The yield stress then becomes appreciable again. It is usually this range (beyond the point of positive charge neturalization and up to the point of the onset of lamellar flocculation) that is of importance in the case of drilling muds.

Comparison with other systems. The effect of zeta-potential on the viscosity of clay suspensions does not differ from its effect on the viscosity of suspensions of other particles. Hauth[16] has shown that the viscosity of alumina suspensions is low with high positive zeta and that it increases as the zeta decreases with increase of pH. At the isoelectric point, viscosity shows a maximum; then, with increasing negative zeta, viscosity rapidly decreases. In other words, the system shows the effects to be expected when the repulsive forces increase because of an increase in zeta.

A clay system might be expected to behave in a similar manner; however, only the particle edges pass through an isoelectric point and the total effective charge on the particle

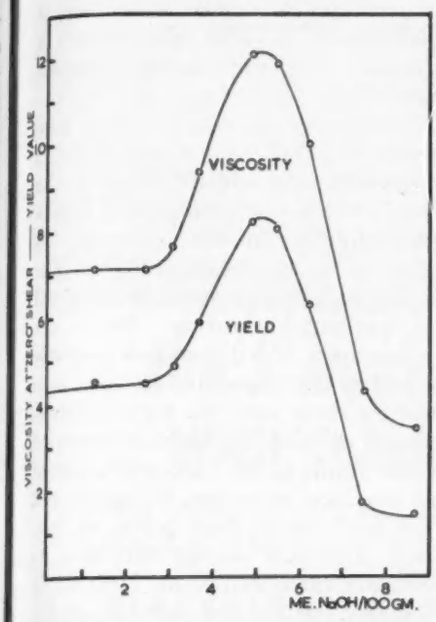

FIGURE 5—Yield stress and viscosity will vary with an increase in NaOH.

remains negative. The existence of oppositely charged areas on their surface, links particles together. Whereas alumina deflocculates, the clay system can only expand and uncoil its flow units up to the pH where the positive areas on its surface are neutralized and normal deflocculation can occur.

Experimental. Viscosities and yield stresses were determined on a 1.03 S.G. suspension of a kaolinite prepared as previously described.[4]

Figure 5 shows the results obtained on the neutralization (by sodium hydroxide) of a suspension of this hydrogen clay. The η_o curve parallels the yield stress curve so either may be used to describe the inter-particulate forces. The maximum of the curves occurs at pH about 7.5 where the zeta-potential also increases sharply. For a montmorillonite type clay this maximum occurs at pH about 4.5. This is the isoelectric point of the edges for this higher SiO_2 containing mineral.

Table 1 and Figure 6 show values of c, η_o, and $\eta\infty$ (Equation 3) for the addition of 7 m.e./100 gm of sodium, potassium, and lithium hydroxides to the hydrogen clay suspension (the exchange capacity is 6 m.e./100 gm). Since this addition of hydroxides is slightly more than sufficient to neturalize the clay and replace the hydrogen ions previously associated with the 001 surfaces, this means that kaolinite should be present in suspension in either the Li, K, or Na form and slight excess electrolyte will cause more deflocculation.

Apparent viscosities of these suspensions can be described in terms of Equation 3. The values of $\eta\infty$ are controlled by the size of the (shear) dispersed clay particles and are equal whatever cation is associated with the clay. Values of η_o are controlled by the size and shape of the flow units at low shear rates and are dependent on the values of both zeta-potential and the degree of hydration of the cation concerned, since these control its expansion.[4] It seems possible that the constant c is a parameter connected with the hydration of the particular cation and the zeta potential of the clay particle.

Table 2 gives measured viscosity values for this sodium clay together with values calculated by Equation 3 using the constants of Table 1, values calculated from equation (4) and using $\eta\infty$ = 2.1 c.p. and f = 4.7 dynes/cm.[2]

Table 3 shows values for η_o and $\eta\infty$ for this kaolin when just neutralized (6me./100 gm.) by the cations listed. It can be seen that the $\eta\infty$ values are approximately equal, they are slightly higher than those listed in Table 1 since there has been no deflocculation. Apparently, shearing cannot completely deflocculate them and the flow units are more assymetrical than when slightly more electrolyte is added. The η_o values clearly show the effect of the different cations. The high hydration and high zeta-potential of the lithium clay produces a very assymetric expanded chain particle and consequently a very high η_o. The lower hydration of the sodium clay coupled with a high zeta-potential gives a medium η_o value while the high zeta but low to zero hydration of the potassium clay gives relatively small expansion and low η_o.[4] Both barium and calcium clays have a low η_o. In these cases, the zeta is low and the chain extension is due to the hydration of the cations.[4]

Application to mud systems. Natural bentonite from which drilling muds are made usually is in the sodium form. When bentonite is made up into a suspension in water (usually slightly acid through dissolved carbon dioxide), the particles are in the extended chain structure because of edge to face flocculation and relatively high 001 face zeta-potential. If the natural bentonite were in the calcium form, the considerably lower dissociation of calcium (than sodium) bentonite would give a lower zeta-potential. The repulsion between the 001 faces would be less than for the sodium type, the chain would be more coiled and a lower apparent viscosity and yield stress would be apparent.

Viscosity reducing agents, such as

TABLE 1—Constants for use in Equation (3)

	KOH	NaOH	LiOH
c	0.0042	0.0038	0.0034
η_o	5.51	7.11	15.59
$\eta\infty$	2.2	2.1	2.1

TABLE 2—Viscosity values of a sodium clay are measured together with values calculated by Equation (3)

dv/dr	η_a (meas.)	η_a (Equat^{n}3)	η_a (Equat^{n}4)
126	5.3	5.3	5.8
308	4.4	4.4	4.4
385	3.8	3.8	3.8
367	3.4	3.4	3.4
416	3.2	3.2	3.2
472	3.0	3.0	3.1

TABLE 3—η_o and $\eta\infty$ values for kaolin when just neutralized by the listed captions

Cation	η_o	$\eta\infty$
Ba	7.2	2.5
Ca	7.6	2.4
K	8.5	2.6
Na	10.0	2.5
Li	17.2	2.5

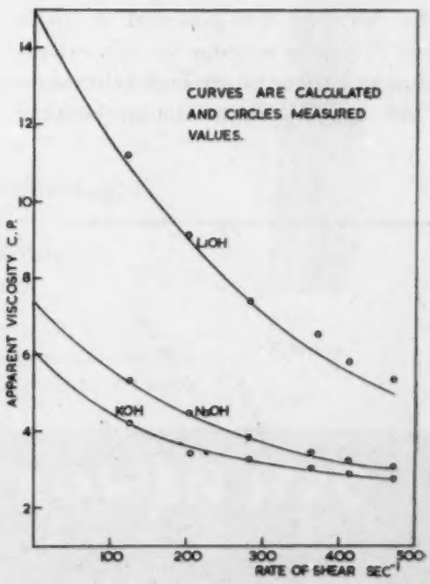

FIGURE 6—The apparent viscosity will vary with the rate of shear for Li, Na and K clays.

sodium hexametaphosphate (or an organic dispersant), are absorbed, neutralize the edge positive charge, and destroy the edge to face flocculation. The result is a very considerable decrease in viscosity.

While bentonite is in the heterocoagulated form, addition of small amounts of sodium chloride gives a lower yield value.[17] The NaCl compresses the double layer and decreases the zeta-potentials of both the negative and the positive areas lessening the attraction between these parts. Dispersion of the sodium bentonite in fresh water permits development of the double layers with resultant high zeta-potential and face to face repulsion. The coils expand and unravel. Addition of small amounts of sodium chloride gives the effects noted above; further addition reduces the zeta to a point where the van der Waal's attraction is dominant and a high yield value results.

If the bentonite is dispersed in a solution of sodium chloride, there is no chance for the coils to unravel since at no time is a high 001 face zeta-potential developed. The chains stay coiled and the viscosity remains relatively low.

A red lime high pH mud has clay particles whose positive areas are neutralized because of adsorption of polyanion and the high pH of the system. Also, calcium ions from the solution largely replace the exchangeable sodium ions on the 001 surfaces and, since the dissociation of calcium clay is much less than that of sodium clay, the resulting zeta-potential is much less. There is no edge to face attraction and hence no chain development. Van der Waal's attraction between the plates develops, together with some linking through the divalent calcium ion.[18] This linkage is too strong for shear breakage and the final result is a decrease in volume concentration, dissymetry and apparent viscosity.

Water loss. Water loss is controlled by packing of the particles. If the zeta-potentials are high, the particles can settle to close packing; if it is low, the packing is voluminous and the water loss is high. The closest packing occurs in the case of deflocculated systems.

These systems that are flocculated edge to face possess relatively voluminous but roughly spherical particles with an effective low negative zeta. Settlings from these suspensions gives a filter cake that is reasonably permeable and has a medium water loss. Expansion of these floccules to a chain structure gives a system such that (although the flow units have relatively high negative zeta's) the high degree of dissymetry prevents close packing. The water loss from these systems is greater than in any other type.

Medium to high water losses result from filter cakes produced from suspensions flocculated by van der Waal's attraction. Since the low zetas prevent the particles settling to close packing, adhesion occurs on contract and a voluminous packing generally results; however, this is less so than for the extended chain type. Special reagents such as CMC are added to some mud types to decrease water loss. Since many of these substances are polyanions, they also affect viscosity. Their effect will not be the same in all cases. For example, Packter[19] observed that addition of CMC to a montmorillonite has very little effect if the clay is prehydrated. A large effect results if the clay is dispersed in the polyanion solution.

Street observed that a sodium kaolinite decreased in viscosity when a polyanion was added.[5] It was also found that a heterocoagulated hydrogen kaolinite initially increased its viscosity on polyanion addition. The hydrogen kaolinite could be dispersed on prolonged shearing. When the polyanion is added then it is probably adsorbed on the positive surfaces, neutralizes them and the clay deflocculates if the clay is present in extended chain form. If the clay is flocculated so that the polyanion molecules can link particles at their points of contact, the extra energy necessary to separate them causes an increase in viscosity. Once they are separated, they absorb polyanion from the solution and remain dispersed.

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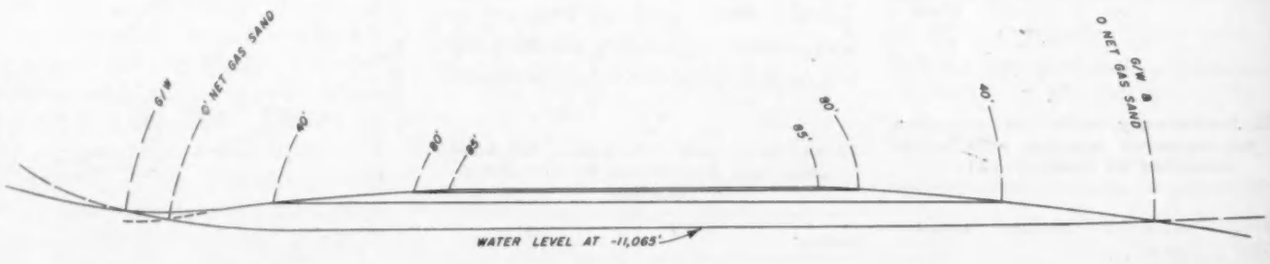
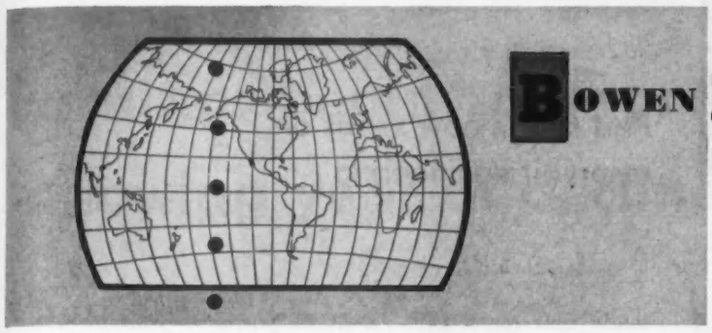


CORRECTION: This illustration—an isopached wedge formed by intersection of the fault plane with structural sand tops and water table—is reprinted from Page 132 of the November, 1958, issue of WORLD OIL. The drawing, as published, was in error. This corrected drawing should be substituted for Figure 4 in the article "Wedging does make a difference" by Don Whitaker.



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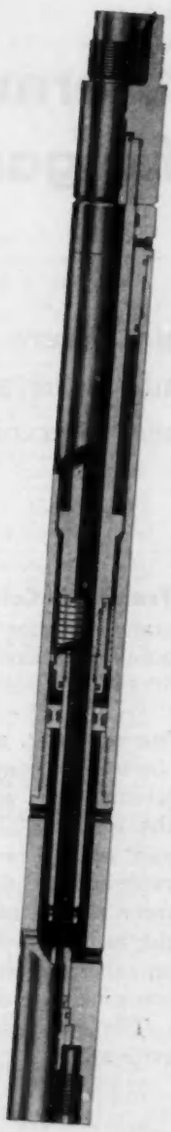

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For Your PRODUCTION File

Part 6 of a new series on reservoir engineering

Determine the size of a gas reservoir

Better future development drilling plans result if the approximate areal extent of a new reservoir can be calculated

By Frank W. Cole
Assistant Professor Petroleum Engineering
School of Petroleum Engineering
University of Oklahoma, Norman, Okla.

THE MATERIAL BALANCE equation for a gas reservoir can be used in conjunction with the volumetric equation to determine the approximate number of acres occupied by the reservoir. This technique is particularly advantageous when a well has been drilled into a new gas reservoir and it is desired to know the size of the resevroir in order to determine whether additional wells can, or should, be drilled. This technique has the same limitation as any other application of the material balance; i.e., the accuracy increases as more production data become available. The equations used to determine the size of the reservoir are:

$$G = \frac{V_g v}{\left(\frac{v}{v_o} - 1\right)} \qquad (1)$$

and

$$G = 7{,}758\, Ah\phi\, (1 - C_w) \qquad (2)$$

Where: G = Gas reservoir space, barrels.
V_g = Cumulative gas produced, scf.
A = Areal extent of reservoir, acres.
v = Gas conversion factor, Bbls/scf.
h = Thickness of reservoir, feet.
ϕ = Porosity of reservoir, fraction.
C_w = Connate water saturation, fraction.
7,758 = Conversion factor, barrels per acre-foot.

After one well has been drilled, the assumption must be made that reasonable values of porosity, connate water saturation and reservoir thickness are available. Equations (1) and (2) can be combined to solve for *A:*

$$A = \frac{V_g v}{7{,}758\, h\phi\, (1 - C_w)\left(\frac{v}{v_o} - 1\right)} \qquad (3)$$

The only unknown in Equation (3) is *A,* the areal extent of the reservoir. Equation (3) must be used only with a full realization of its weaknesses. Where only one well has been drilled, good values for average reservoir thickness, porosity and connate water saturation may not be available because of the limited amount of data. However, probably more important are the limitations imposed by the material balance equation. The factor $(v/v_o - 1)$ is a very small number early in the life of the reservoir, and small errors in the numbers which make up this factor can lead to large errors in the final answer. An example calculation shows the potential magnitude of the error involved. A reservoir which had an original pressure of 3,000 psia has produced 60,000,000 scf of gas when the reservoir pressure had declined to 2,800 psia. Reservoir thickness is 10 feet, porosity 10 percent, and interstitual water saturation is 35 percent.

(1) Calculate the areal extent of the reservoir.

(2) Calculate the areal extent of the reservoir if the reservoir pressure had been incorrectly determined to be 2,900 psia instead of 2,800 psia.

Solution:

$$(1)\ v_o = 0.00504\frac{Z_o T_o}{P_o} = (0.00504)\ \frac{(0.88)\ (635)}{3000} = 0.000940$$

$$v_{2800} = 0.00504\frac{ZT}{P} = (0.00504)\ \frac{(0.87)\ (635)}{2800} = 0.000993$$

$$A = \frac{V_g v}{7{,}758\, h\phi\, (1 - C_w)\left(\frac{v}{v_o} - 1\right)}$$

$$= \frac{(60{,}000{,}000)\ (0.000993)}{(7{,}758)\ (10)\ (0.10)\ (1 - 0.35)\left(\frac{0.000993}{0.000940} - 1\right)}$$

$$= 210 \text{ acres}$$

$$(2)\ v_{2900} = 0.000504\frac{ZT}{P} = \frac{(0.00504)\ (0.87)\ (635)}{2900} = 0.00096$$

$$A = \frac{(60{,}000{,}000)\ (0.00096)}{(7{,}758)\ (10)\ (0.10)\ (1 - 0.35)\left(\frac{0.00096}{0.00094} - 1\right)}$$

$$= 520 \text{ acres}$$

Thus, an error of 3.6 percent in the measurement of reservoir pressure resulted in an error of 248 percent in the calculated areal extent of the reservoir.

TO BE CONTINUED

Earnings begin to improve following year of decline

By L. J. Logan
World Oil Staff

All but a relatively few oil companies earned more in the third quarter of 1958 than in the second quarter. The 1958 third quarter brought a reversal of the decline which had started in 1957's third quarter.

The improvement was not quite enough, however, to make third quarter earnings as large in 1958 as in 1957. For 48 companies, third quarter profits this year were 2.2 percent short of those last year.

During the fourth quarter of 1958, earnings are expected to equal or exceed those of the third quarter. They are quite likely to be better than in the final quarter of 1957. In that period they were continuing the decline that had started in the 1957 third quarter.

Earnings are being aided in the 1958 final quarter by continued improvement in demand for oils. Crude production and refinery runs have been increased in recent months. Prices of products and some crude oils have weakened since the beginning of fall. The increased operations and price decreases have been offsetting influences on earnings. But the larger business volumes may have outweighed the lower prices and provided some expansion of earnings.

In 1957 and 1958 oil company earnings have fluctuated widely. They were at exceptionally high levels in the first and second quarters of 1957. But in the third quarter of 1957 they were off about 7 percent from a year earlier. In the fourth quarter, 1957, they continued to decrease and were about 13 percent below a year previously.

In the first quarter of 1958 the earnings were down about 33 percent from a year before. In the second quarter, 1958, they showed their worst year to year comparison, having been off about 38 percent. Improvement then began, and for the third quarter, 1958, the earnings decrease of only about 2 percent was an encouraging showing. For the fourth quarter of 1958 an increase is promised. If it materializes, it will represent the definite emergence of the industry from the latest recession and a return toward normal conditions.

Earnings were substantially better in the 1958 third quarter than in the second quarter for most oil companies of all classes, including international, integrated, producing, refining, and marketing concerns. Better volume and better prices aided them all.

For the first nine months of 1958, earnings were 25.4 percent lower than in the like period of 1957 for 48 companies. The decrease reflected the unfavorable results in this year's first half. A smaller decrease is indicated for the whole year 1958, in view of prospective good fourth quarter earnings.

Net Earnings of Some Oil Companies in 3rd Quarter and First 9 Months, 1958 vs. 1957

(All "per share" data based on number of shares of common stock outstanding Sept. 30, 1958.)

	3RD QUARTER					FIRST 9 MONTHS				
	$ Thousand		$ Per Share		%	$ Thousand		$ Per Share		%
COMPANY	1958	1957	1958	1957	Diff.	1958	1957	1958	1957	Diff.
Anderson-Prich.	1,380	1,255	.77	.69	+ 10	2,757	4,075	1.48	2.28	—32
Argo Oil	1,337	1,303	.68	.66	+ 3	3,758	4,126	1.92	2.10	— 9
Ark. Fuel Oil	1,378	1,993	.36	.53	— 31	4,701	5,918	1.24	1.56	—21
Ashland O. & R.	2,977	3,394	.45	.52	— 12	6,757	11,969	1.11	2.02	—44
Atlantic Ref. Co.	11,513	3,972	1.24	.41	+188	19,180	29,294	2.02	3.15	—35
Aztec O. & G.	735	212	.31	.09	+247	1,326	721	.55	.30	+84
Barber Oil Corp.	d61	d45	d.08	d.06	.....	d210	17	d.29	.02	.....
Bishop Oil Co.	53	18	.10	.03	+199	99	162	.18	.29	—39
Champlin O. & R.	2,083	1,908	.49	.41	+ 9	4,948	7,249	1.15	1.70	—32
Cities Service Co.	7,693	9,340	.73	.89	— 18	32,312	45,656	3.07	4.34	—29
Clark O. & R. Co.	417	391	.29	.27	+ 7	639	1,084	.45	.77	—41
Colorado O. & G.	d706	685	.....	.17	.....	d111	2,139	.....	.56	.....
Continental Oil	13,086	11,148	.66	.57	+ 17	33,294	34,862	1.69	1.78	— 4
*Creole Pet. Corp.	88,105	97,159	1.14	1.25	— 9	249,018	318,807	3.21	4.11	—22
Delhi-Taylor Oil	341	236	.06	.04	+ 44	d1,056	4,340	d.20	.82	.....
Felmont Pet. Corp.	561	978	.15	.26	— 43	1,503	2,645	.41	.72	—43
Getty Oil Co.	4,577	2,557	.29	.15	+ 63	12,557	15,519	.77	.95	—19
Gulf Oil Corp.	88,513	74,457	2.74	2.30	+ 19	204,393	276,212	6.31	8.53	—26
Hancock Oil	1,481	1,550	.39	.41	— 4	4,791	5,385	1.26	1.42	—11
Honolulu Oil	3,010	3,675	.80	.98	— 18	8,595	11,291	2.29	3.01	—24
*Imperial Oil	10,174	20,759	.32	.65	— 51	34,327	58,421	1.09	1.85	—41
Leonard Refineries	427	530	.38	.47	— 19	1,202	1,658	1.07	1.48	—27
La. Land & Explo.	4,114	5,103	.46	.57	— 19	12,975	15,606	.45	1.74	—17
Maracaibo Oil	80	113	.16	.23	— 29	219	814	.45	1.66	—73
Midwest Oil Corp.	1,656	1,575	.65	.62	+ 5	5,003	5,187	1.97	2.05	— 3
Ohio Oil Co.	7,941	9,774	.60	.75	— 19	23,028	32,007	1.75	2.44	—28
Phillips Pet. Co.	21,198	20,829	.62	.61	+ 2	57,609	74,227	1.68	2.16	—22
Pure Oil Co.	6,741	7,135	.78	.83	— 5	17,416	26,147	2.02	3.04	—33
Quaker State	529	633	.64	.77	— 16	1,340	1,591	1.62	1.93	—16
Richfield Oil	4,856	8,069	1.22	2.01	— 40	15,265	21,774	3.82	5.44	—30
Shell Oil Co.	32,637	30,477	1.08	1.01	+ 7	78,289	105,798	2.58	3.49	—26
Signal O. & G.	2,760	3,151	.55	.63	— 12	8,420	9,287	1.68	1.85	— 9
Sinclair Oil Corp.	10,561	18,031	.69	1.18	— 41	35,368	62,879	2.31	4.11	—44
Skelly Oil Co.	6,995	8,298	1.21	1.44	— 16	17,544	28,231	3.05	4.91	—38
Socony Mobil Oil	48,200	48,000	.99	.99	.....	115,700	174,800	2.39	3.62	—34
Standard, Calif.	71,008	75,436	1.12	1.19	— 6	187,744	211,765	2.97	3.35	—11
Standard, Ind.	34,026	31,296	.95	.87	+ 9	86,449	113,873	2.42	3.18	+24
Standard, Ky.	4,141	3,226	1.59	1.24	+ 28	10,442	9,559	4.01	3.67	+ 9
Standard, N.J.	171,000	197,000	.83	.95	— 13	462,000	660,000	2.23	3.19	—30
Standard, Ohio	6,038	1,959	1.21	.37	+208	17,474	14,581	3.50	2.90	+20
Sun Oil Co.	11,062	13,826	.97	1.21	— 20	22,622	39,014	1.98	3.42	—42
Sunray Mid-Cont.	8,829	11,177	.45	.59	— 21	28,080	36,012	1.46	1.92	—22
Texas Company	89,157	77,958	1.53	1.34	+ 14	227,693	243,104	3.90	4.16	— 6
Texas Gulf Prod.	907	1,294	.23	.32	— 30	2,524	4,960	.63	1.23	—49
Texas Pac. C. & O.	1,813	1,566	.47	.40	+ 16	4,166	5,515	1.08	1.42	—24
Tidewater Oil Co.	d607	5,432	d.10	.35	.....	d328	27,001	d.19	1.87	.....
Union Oil, Calif.	9,373	10,949	1.19	1.39	— 14	20,830	27,676	2.65	3.52	—25
Union O. & G, La.	1,654	1,174	.91	.64	+ 41	5,745	4,542	3.15	2.49	+27
Universal Consol.	804	813	.84	.85	— 1	1,928	2,740	2.01	2.86	—30
Woodley Pet. Co.	753	797	.92	.97	— 5	2,034	2,546	2.48	3.10	—20
*Total, 48 Companies	699,021	714,648	.....	.....	—2.2	1,809,014	2,425,558	.....	.....	—25.4

* Creole and Imperial are excluded from totals, being included as affiliates of Standard (N.J.)
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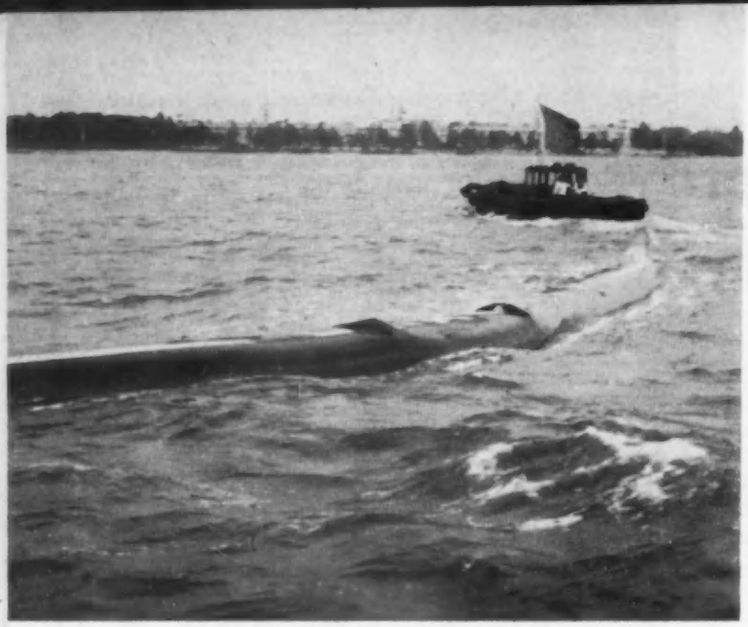
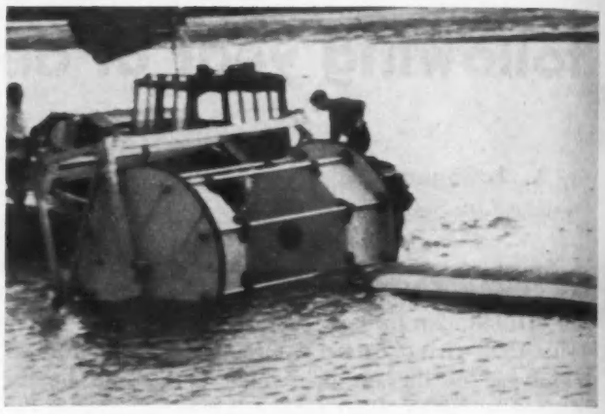


Flexibility of the new "sausage skin" barge is shown at left as it makes a turn during demonstration in Southampton Water, England. While unloading its petroleum cargo from the stern, (below) the flexible barge's nose is shown entering the reel around which it is wound after being emptied.



More "sausage skin" barges on the way

By George Sell
Institute of Petroleum, London, England

SUCCESSFUL TESTS of England's widely publicized "sausage skin" oil products tanker have resulted in plans to construct another, the same size as the original.

Also, designs and materials for a 300-ton barge have been prepared.

The first nylon "tanker" has undergone extensive tests in Southampton Water, England. It is a flexible towed container or barge, five feet in diameter and 100 feet long, the ends being equipped with a towing connection at the nose and a hosepipe connection at the stern. A stabilizing device is attached to the stern.

Looking very much like an inflated sausage, the new barge was developed by Dracone Developments, Ltd., an organization formed in 1957 with the support and financial backing of the National Research Development Corporation, an official body set up by the British Board of Trade to secure the development and/or exploitation of inventions.

Of "stressed skin" construction, the skin is $\frac{5}{32}$-inch thick and consists of a woven nylon fabric with synthetic rubber on both sides. Total weight is 2,300 pounds, of which about 200 pounds is the weight of nylon used to give mechanical strength.

For the demonstration, the flexible barge was filled with 12,500 U. S. gallons (37 tons) of kerosine, and towed behind a 60 horsepower launch at speeds up to 5½ knots. At the end of the tests it was towed to its base and the cargo was discharged into a small tanker. As the cargo was removed, the barge was wound on to a floating reel.

While the 100 foot barge is regarded as a preliminary step to vessels of much larger capacities, the smaller version will still have considerable application on inland waterways.

The barge may also have applications for storage of liquids at isolated drilling sites.

Development history. The flexible barge was originally conceived by three Cambridge University scientists in the autumn of 1956. It was shown that some existing fabrics could withstand the static stresses involved, and a 16-foot model nine inches in diameter was tested in a towing tank.

Larger models were later tested in the North Sea under weather conditions from calm to gale. During these tests means were devised to prevent yawing and snaking, enabling the barge to be towed straight with only a small increase in drag.

Further investigation into materials and construction methods led to the design of the present 100-foot model. For storage and transport in its empty state, the barge can be removed from its spool and folded, rolled or stowed in a packing case. It can then be transported by boat, train, truck, or even by air if necessary.

Provisional data now available for three sizes of barges include the following:

Diameter, feet	5	10	15
Length, feet	100	200	300
Capacity:			
U. S. Gallons	12,000	90,000	324,000
Tons @ 35 API, approx.	40	300	1,100
Draught, feet:			
Maximum	4	8	12
Normal	3.5	7	10.5
Max. economical speed, Knots	7	10	12
Drag at economical speed, lbs.	800	6,000	19,000
Drag at 7 knots, lbs.	800	2,000	3,500
Empty weight, tons	1	4	8

—The End

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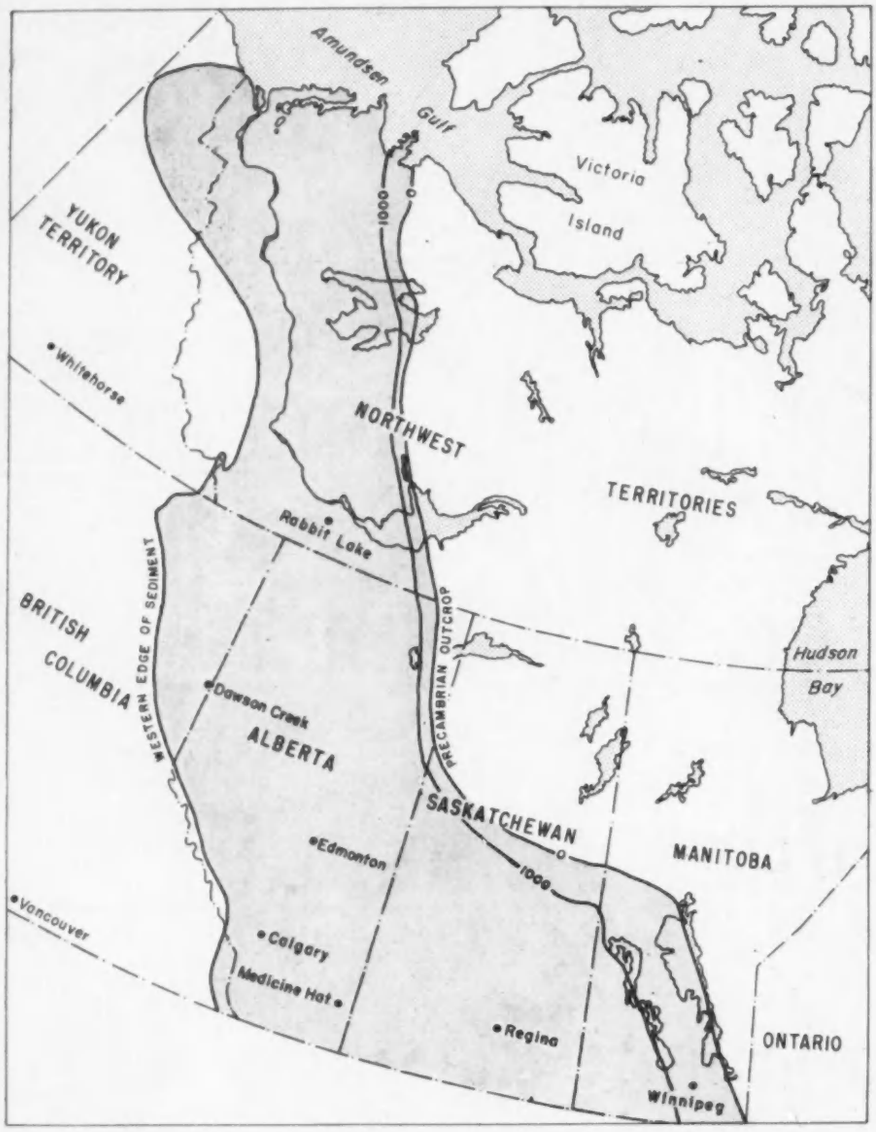

FIGURE 1—Map of Western Canadian Sedimentary Basin.

New fields boost Canada's natural gas reserves

Ultimate reserves in Western Sedimentary Basin may exceed 250 trillion cubic feet

By J. Stabback, Gas Engineer
Oil and Gas Conservation Board, Calgary, Alberta, Canada

NATURAL GAS RESERVES in the Western Canada Sedimentary Basin as of January 1st, 1958, have been estimated at 23.6 trillion cubic feet. New discoveries and extensions since the first of the year have advanced this figure beyond 25 trillion cubic feet.

An ultimate recoverable reserve (before production) of over 250 trillion cubic feet is estimated for the area, about 90 trillion cubic feet being allocated to Alberta.

The Western Canada Sedimentary Basin covers more than 700,000 square miles, extending from the 49th parallel to the Arctic Ocean. It includes the southwestern tip of Manitoba, the southern half of Saskatchewan, all but the northeastern corner of Alberta and portions of British Columbia, Yukon and the Northwest Territories (Figure 1).

Natural gas was first discovered in Western Canada in 1883 at Alderson, Alberta.[1] In 1904 the Medicine Hat field was discovered. Limits of this field have been greatly extended and have not been completely defined although the field now covers an area in excess of 700 square miles. Other natural gas "firsts" in the area include Saskatchewan, 1934; British Columbia, 1948. No significant gas discoveries have been made in Manitoba and its nominal gas reserves consist of solution gas only.

The Yukon and Northwest Territories remain relatively unexplored, but significant oil and gas discoveries are expected in the future.

Reserves shown in Table 1 are disposable gas defined as 100 percent of the proven and 50 percent of the probable reserves, all in terms of pipeline gas. Where surface losses such as fuel gas and shrinkage are unknown, the average surface discount for the Alberta reserves as estimated by the Oil and Gas Conservation Board has been applied.

Predicting ultimate reserves geologically. As previously mentioned, the area of the Western Canada Sedimentary Basin exceeds 700,000 square miles. It increases in sedimentary thickness from the Pre-Cambrian outcrop on the northeast to some 15,000 feet along the western edge of the plains and to even greater thicknesses in the foothills where thrust faulting causes repetition of formations. Total volumes of sediments in the basin have been estimated at 957,000[2] and 1 million[3] cubic miles.

A third study[4] contains an estimate of 789,000 cubic miles of basin sediments which are in excess of 1,000 feet in thickness and which are considered favorable for prospecting for

ACKNOWLEDGMENT

This article is based on a paper presented at the Rocky Mountain Regional Meeting, NGAA in Casper, Wyoming, Sept. 18, 1958.

TABLE 1—Established Natural Gas Reserves of Western Canada As of January 1, 1958
B.C.F. @ 14.4 p.s.i. and 60°F.

ESTIMATOR	Manitoba	Saskatchewan	Alberta	British Columbia	Northwest Territories	Total
Canadian Petroleum Association	2.7	880.0	18841.5	1814.1	38.1	21576.4
Government of Saskatchewan	..	1996.0	.....	.....	....	.....
Oil and Gas Conservation Board (Alberta)	..	.....	21048.4	.....	....	.....
Government of British Columbia	..	.....	.....	1590.0*	....	.....
British American Oil Company Limited	..	.....	.....	.....	....	23099.4
Westcoast Transmission Company Limited	..	.....	22300.0	2200.0	....	.....
Average	2.7	1438.0	20730.0	1868.0	38.1	23588.1

*June 30th, 1957 Proven Reserves extrapolated to January 1, 1958.

hydrocarbons. Results of the two previous studies have been adjusted to eliminate the approximately 10,000 cubic miles of sediments lying between the 1,000-ft. and zero contours shown in Figure 1.

Averaging the results of the three studies, an estimate of 910,000 cubic miles of favorable sediments is obtained. The corresponding figure for the Province of Alberta alone would be 325,000 cubic miles.

A rough indication of the total recoverable oil reserves that may have accumulated within the sparsley explored Western Canada Sedimentary Basin can be obtained by calculating the volume of the effective sediments within the basin and assigning to this volume an "accumulation factor" expressed in terms of barrels of recoverable oil per cubic mile of sediments. The "accumulation factor" should be derived from an intensively explored and developed basin or group of basins that closely resemble, geologically, the basin under investigation.

This method of estimating ultimate oil and gas resources can be unreliable owing to the extreme variation in the degree of concentration of gas or oil reserves that exist beneath different basins or beneath different portions of a specific basin. The inaccuracies of the method can be reduced only by exhaustive geological studies of the basins being investigated.[5]

Applying this "basin criteron" and based on production histories of basins in the United States, it is difficult to establish an accurate average "accumulation factor" for the occurrence of natural gas, since no records are available on the quantities of gas produced and flared during the first part of the century. However, an estimate can be undertaken by calculating the ratio of total established reserves of recoverable gas to the recoverable oil reserves discovered up to the present time in Western Canada, and applying this ratio to the ultimate total oil reserves calculated by the "accumulation factor-basin volume" method.

Up to Jan. 1, 1958, the industry had found in Western Canada more than 6,000 cubic feet of gas for every barrel of recoverable oil.[3] This ratio is almost identical to that calculated for Alberta by the Oil and Gas Conservation Board, and corresponds closely to the ratio of presently remaining gas reserves to oil reserves in the United States. In using this ratio, it should be borne in mind that the ratio can change with time and that it is subject to wide variations within portions of the basin.

With these basic factors it is now possible to estimate the ultimate reserves of oil and gas which may be established within the Western Canada Sedimentary Basin. By using the presently defined United States' "accumulation factor," an ultimate reserve (before production) of 42 billion barrels of recoverable oil is estimated for the Western Canada Sedimentary Basin, some 15 billion barrels of this total being allocated to Alberta. By applying the expected gas-oil discovery ratio to these totals, an ultimate established recoverable reserve of natural gas (before production) of over 250 trillion cubic feet is estimated for the Western Canada Sedimentary Basin, about 90 trillion cubic feet being allocated to Alberta.

The estimates might be considered conservative in view of the fact that they are based on the incidence of presently known reserves for the United States as a whole, instead of the more closely allied Mid-Continent region which has a higher "accumulation factor." Moreover, L. G. Weeks has estimated that the ultimate potential resources of liquid hydrocarbons in the United States are more than two and one-half times the reserves that have been discovered to the present.[5]

On the other hand, certain types of fields which are economic to find and develop in the United States would not be economic if located in the northern part of the Western Canada Sedimentary Basin. The estimates used, therefore, are considered realistic at the present time.

Method of predicting ultimate reserves statistically. The Oil and Gas Conservation Board, Province of Alberta, has made continuing statistical studies since 1952 with respect to the trends in exploration and growth

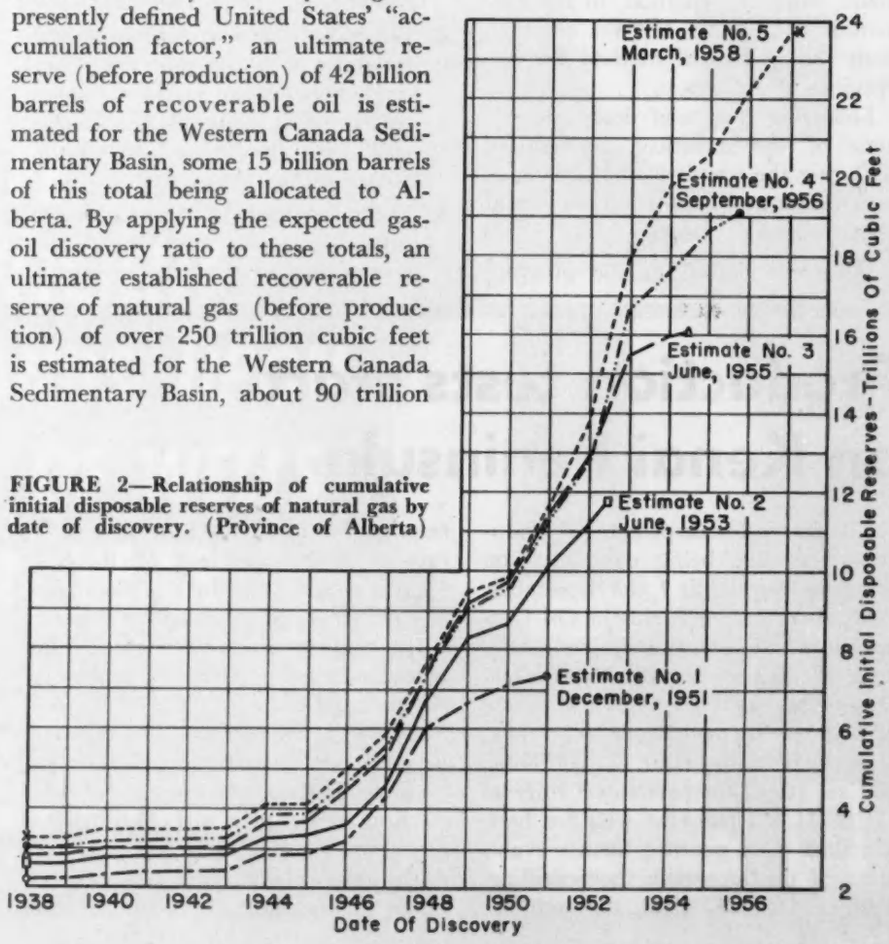

FIGURE 2—Relationship of cumulative initial disposable reserves of natural gas by date of discovery. (Province of Alberta)

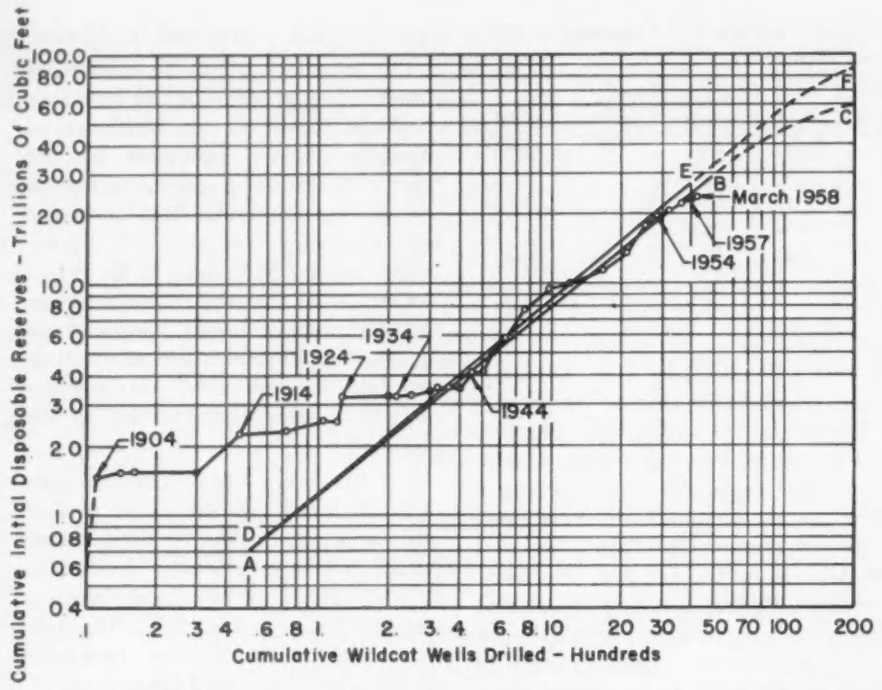

FIGURE 3—Trends in the growth of initial disposable reserves of natural gas. (Province of Alberta)

of natural gas reserves in the province. These studies have been included in several board reports.[6] While similar studies have not been made for the balance of the Western Canada Sedimentary Basin, a comparison can be made, using this method, to the estimation of ultimate reserves obtained from the geological method for the Province of Alberta.

Following is a brief description of some of the statistical methods of analyzing the trends in the growth of exploration and growth of reserves as employed by the board:

1. All wells drilled in the province are classified under the supervision of the board's chief geologist generally in accordance awith the system advocated by Dr. F. M. Lahee.[7] A record of the number of wildcat wells drilled each year is maintained.
2. The board's estimate of established gas reserves in the province is revised every year or so. The reserves are estimated generally in accordance with the procedure of the American Gas Association.
3. The relationship of the cumulative initial disposable reserves to the year of discovery of the reserve is established as shown in Figure 2.
4. The trend in the growth of the cumulative initial disposable reserves in relation to the number of wildcat wells drilled is determined from the history of drilling to date and extrapolated to the cumulative number of wildcat wells expected to be drilled by the time the province has been effectively saturated (assumed to be approximately one wildcat well per 10 square miles or a total of 20,000 wildcat wells). Line ABC in Figure 3 indicates such a trend.

From an analysis of the curves shown in Figure 2, it has been possible to determine the amount by which the reserves of fields discovered up to and including the date of certain reserve estimations have increased in size when re-evaluated in the future. In other words, the degree of under-estimation of reserves due to lack of development of recently discovered fields can be ascertained. For example, referring to Figure 2, the estimate of reserves of fields discovered up to and including 1950, increased from 7.2 trillion cubic feet shown in Estimate 1 to 8.7 trillion cubic feet shown in Estimate 2 and 9.9 trillion cubic feet indicated in the most recent estimate, Estimate 5.

5. The rate of increase in reserves with time may be obtained from Figure 3, by estimating the number of wildcat wells which will be drilled each year.

In Alberta, the average for the past several years has been approximately 400 per year. Continuing at this rate,

Production tests start on Kenai Peninsula

The first full-scale production evaluation tests are being conducted on Swanson River Unit 1, the September, 1957, discovery of Richfield Oil Corporation, on the Kenai Peninsula, some 40 miles southwest of Anchorage. Originally completed at an initial rate of 900 barrels per day through 1½-inch choke, along with 122,000 cubic feet of gas, from perforated interval 11,150-11,215 feet, the well has been idle since then, pending further evaluation of the area with more drilling.

Since Oct. 11, 1958, the well has been producing at 500 barrels per day rate of 32 gravity clean oil through $^{12}/_{64}$ths choke. Standard Oil Company of California, as operator of the Unit, is trucking the crude to Seward, from where it is being lifted by tanker to Richmond, Calif.

Although the operator has released no additional information, there is little doubt but that the outcome of production tests, plus the findings of other wells either already completed or drilling, will determine how soon an outlet may be planned for this first major producing area of Alaska. A pipe line to Seward, some have estimated, might cost anywhere from $10 to $20 million.

Earlier this year, a two-mile southerly extension test, although not completed, did penetrate the same productive zone and reports at the time indicated that although the well was shut in with pipe cemented through the zone, the well would be a commercial producer. The operator, meanwhile, was nearing critical depth in its third test of the Unit; this being a ½-mile northeasterly offset to the discovery well. In addition, location presently is being prepared for a fourth test about 1½ miles southwest of the discovery well.

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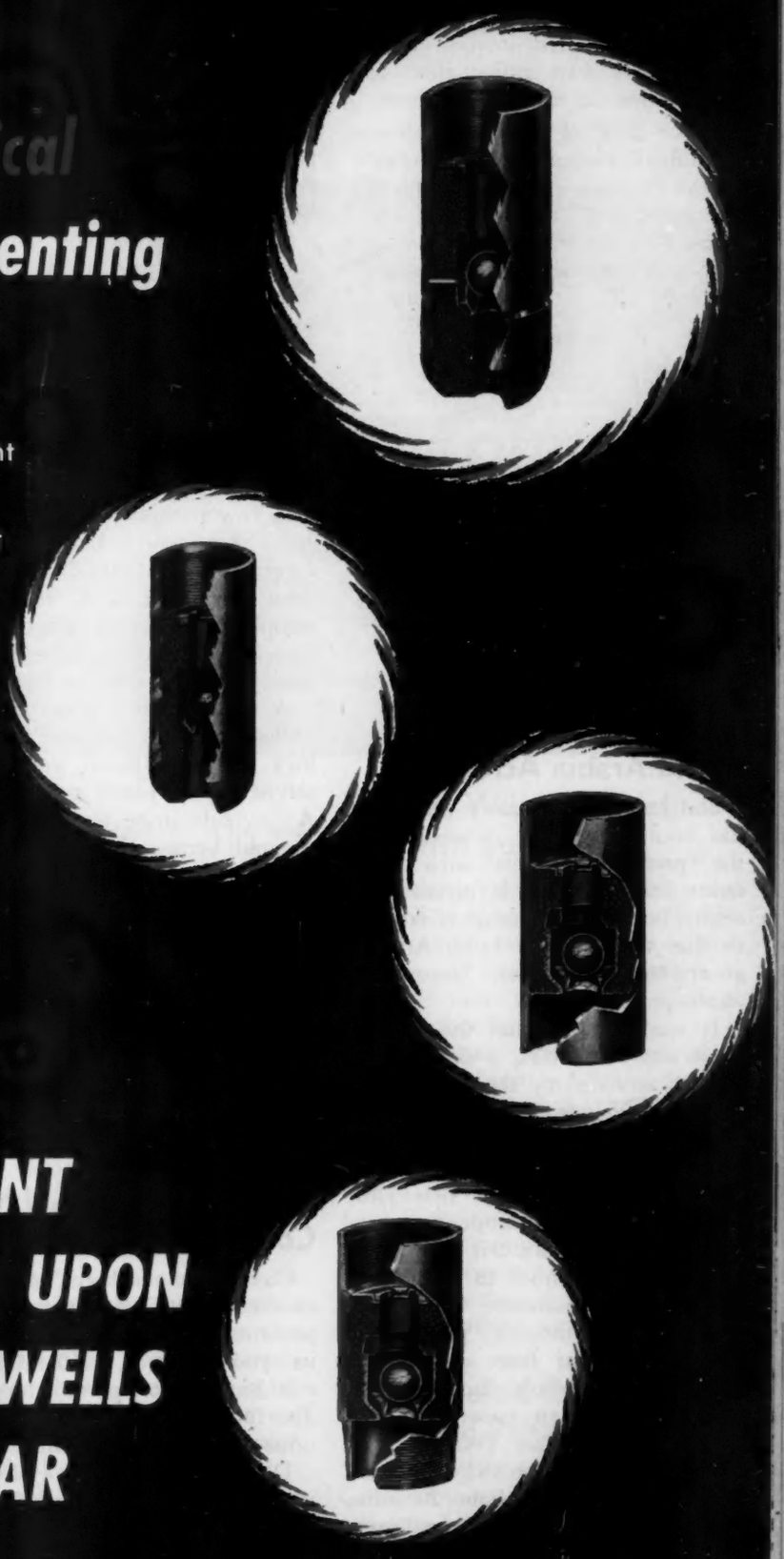

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the reserves should increase at the rate of some two trillion cubic feet per year for the next several years.

Curve DEF of Figure 3 indicates an ultimate cumulative initial reserve for the Province of Alberta of 85 trillion cubic feet. This is to be compared with the 90 trillion cubic feet previously suggested, using the geological approach.

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Indiana Standard Seeks Inland Arabia Acreage

Standard Oil Company (Indiana) has been seeking oil concessions in the "preferential rights" area of interior Saudi Arabia. It revealed recently, however, that terms offered up to that time by the Saudi Arabian government had been "completely unacceptable."

It was rumored that the government was demanding a deal similar to that accepted by the Japanese in the area offshore from the Neutral Zone. This would include much participation and control by the Saudi Arab government in the new joint company to be set up under the plan. Arabian American Oil Company would have a chance to match any offer made by Standard of Indiana.

Interest in Aramco's "preferential rights" zone has been greatly enhanced by Aramco's discovery and development of an apparent major oil field at Khurais (WORLD OIL, December, 1957, Page 181). The discovery well is only about 20 miles from the east border of the "preferential rights" area. Both Khurais 2, four miles southwest of 1 and Khurais 3, 5½ miles southeast of 1, have been completed as oil producers.

Khurais field is 90 miles northeast of the capital at Riyadh. It is about midway between Riyadh to the west and the mammoth Ghawar field to the east. It is about 150 miles from the Persian Gulf.

Neutral Zone and Kuwait Facilities Are Expanded

American Independent Oil Company has completed extensive expansion of facilities in Kuwait and the Kuwait-Saudi Arabia Neutral Zone.

The company has built and put on stream a refinery in Kuwait with 30,000-barrels per day capacity. It makes fuel oil and other products from Neutral Zone crude oils.

A new 12-inch pipe line was built paralleling the existing 8-inch-10-inch line from Wafra field, Neutral Zone, to the refinery and shipping terminal at Mena Abdulla, Kuwait.

A new pumping station with four 1,000 horsepower pump units was constructed at Wafra. Tankage additions at Wafra field, refinery and shipping terminal exceeded 1,180,000 barrels. A 270,000-barrel reservoir was also constructed to store fuel oil.

A new tanker sea berth was installed three miles offshore with moorings for 100,000-ton vessels. It is served by a 24-inch submarine line. A new submarine bunker line serves the old berth, which is 12,000 feet offshore, as well as the new berth. The new loading pump station has five 1,000-horsepower pumping units which provide a loading rate of 15,000 barrels per hour at the new berth and 10,000 barrels per hour at the old berth.

New additions have been made to housing for company personnel at Wafra and Mena Abdulla.

Pipe Line Is Planned for Colombia's Cicuco Field

Cicuco field, northern Colombia, discovered in 1956, is proving to be important. Preliminary estimates place its crude reserves at 50 million barrels. But it is only partially developed, and future drilling is expected to increase that estimate greatly.

Discoverer and operator of the field is Colombian Petroleum Company, owned 50 percent by Socony Mobil Oil Company and 50 percent by The Texas Company.

Exploratory as well as development drilling is continuing. About 8,000 acres have been proved so far. Twelve wells had been completed up to a recent date, and the field was capable of producing about 16,000 barrels daily. It yields high gravity, low sulfur crude.

Colombian Petroleum Company will lay a 68-mile, 12-inch pipe line from Cicuco field to its crude terminal at Covenas on the Caribbean. The line will have an initial capacity of 36,000 barrels per day. The construction job will be started when the dry season begins early in 1959. It is expected to be completed in about three months.

The new line will parallel a 12-inch pipe line which runs 255 miles from Colombian Petroleum Company's Barco concession over the Andes and past Cicuco to the sea.

Newer Operators Drilling Good Wells in Venezuela

Good wells are being completed regularly in Venezuela by various groups of U. S. companies on lately acquired concessions.

The Sun-Atlantic-Texas group recently completed SVS 17 in Lake Maracaibo as its fifteenth oil producer and fifth dual producer on its 24,000 acre Block 1 concession, where drilling was started a year ago. The well flowed over 4,000 barrels daily from each of two formations, the upper and lower Eocene.

The first oil production was obtained by a group of eight oil companies on its 25,000 acre Block 17 concession in Lake Maracaibo. The companies include Phillips, Sunray Mid-Continent, Ashland Oil, Kerr-McGee, Western Natural Gas, El Paso Natural Gas, Pacific Petroleum, Ltd., and Canadian Atlantic companies.

This group also holds the concession on the 25,000 acre tract on Lot 9, South Monagas state, Venezuela. Five wells have proved large reserves of low gravity oil over a large portion of that concession.

Persian Gulf's Abu Dhabi Offshore Field Promising

Abu Dhabi Marine Areas Ltd.'s recent offshore oil discovery well in the Persian Gulf has held up well on production tests. It maintained a flow of about 2,500 barrels daily.

The second test of the structure was to be drilled about 10,000 feet west of the discovery well, after moving of the drilling platform.

If the field proves commercial, submarine crude oil pipe lines will probably be laid to Das Island, 20 miles to the west.

Deep test drilled in Pakistan

Pakistan Petroleum Limited is drilling in Mazarani, 48 miles from Larkana, in Pakistan. The company planned to drill to 11,000 feet in this, its thirty-sixth well in Pakistan. Drilling was begun on Aug. 20, 1958.

Burma Oil Drilling First Exploratory Test in the Irrawaddy Delta Region

The Burma Oil Company (1954) Limited started drilling an exploratory well at Hteingyun Village, about 5 miles northwest of Kyaiklat, in mid-September, 1958. This is the first test well ever to be drilled in the Irrawaddy Delta region, the nearest well being about 150 miles to the north.

The drilling of this test well will be the latest step in the exploration of the Delta which began in 1938 when the Burmah Oil Company (Burma Concessions) Limited began the first of a series of geophysical surveys. Exploratory work had to terminate in 1940 because of the war and could not be resumed until 1956, when a further geophysical survey, using the seismic method, began. Each of the geophysical surveys gave increasingly detailed information about the disposition of the rocks buried under the alluvium of the Delta, and by late 1956 the search was temporarily concentrated on an area near Kyaiklat. Since detailed work confirmed an earlier impression that this area might be suitable for a first test well in the region, a location for drilling was selected in mid-1957. There were, of course, no direct indications of the presence of oil or gas. Whether or not these are present in the Delta can only be determined by drilling.

It was decided that the test well should be drilled with equipment capable of reaching a depth of about 13,000 feet. While a new outfit was being prepared for shipment in the U.S.A., a camp was constructed at Hteingyun, on the banks of the Uyin Chaung. Since the area is normally under water during the monsoon season, the whole camp and test well area had to be raised by 3 feet before construction could begin.

On arrival from the U.S.A. less than one month ago, the drilling outfit was transported by barges to the location and was speedily erected under the supervision of the drilling contractor's American staff. Rigging-up operations are now completed and it is hoped that the first string of casing will be set in a few days' time.

The drilling contractor is the Santa Fe Drilling Company of California, U.S.A.

Stanvac Will Drill Well In British Somaliland

Standard-Vacuum Oil Company planned to spud its first deep test in Africa about December 1 in British Somaliland. It is Dagah Shabell 1, about 30 miles south of the Gulf of Aden port of Berbera.

Stanvac has opened a branch office at Hargeisa, capital of British Somaliland, to administer its drilling program.

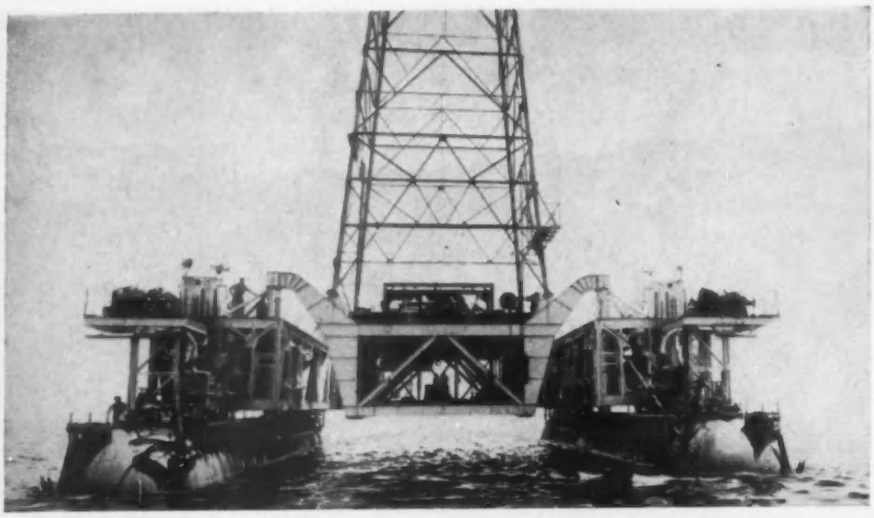
Seacat Drilling Company, an affiliate of Southeast Asia Drilling Company, is the contractor.

Stanvac's concession in British Somaliland covers 11,380 square miles. Extensive geological and geophysical surveys have been completed.

Consolidated Cuban Has Obtained Bahamas Leases

Consolidated Cuban Petroleum Corporation has acquired 1,500 square miles, or 1 million acres of petroleum leases in the Bahamas. The land makes up about two-thirds of Andros Island, largest in the Bahamas archipelago.

Offshore drilling in the Bahamas is being carried out jointly by Bahamas Gulf Oil Company and Bahamas California Oil Company. They are drilling a deep test off Cay Sal bank between the Bahamas and Cuba.



This floating rig mover of Creole Petroleum Corporation is on Lake Maracaibo, Venezuela. It can move all necessary drilling equipment from one site to another, including the derrick. Its immense size is emphasized by noting men at left and in center.

Rig Mover Expected to Simplify Lake Drilling

Creole Petroleum Corporation is operating on a test basis a floating rig mover of advanced design on Lake Maracaibo in Venezuela. The rig mover can move all equipment necessary for drilling a well from one site to the next, including the derrick. The unit represents an outstanding innovation in deep water drilling.

Creole engineers, in collaboration with consulting engineers, conceived and designed the unit to simplify and streamline drilling operations on the lake.

The floating rig mover cost over $900,000. It will simplify exploration for new petroleum deposits under the lake and development of known oil deposits. It will also reduce the number of derricks on the lake, which today give Lake Maracaibo its unique character.

To appreciate the immense size of the new rig mover observe the small figures of the men in the photograph herewith.

Oil Shows Encountered In Western India Test

Oil shows have been reported in a test being drilled by the Indian government in the Cambay area of western India, about 250 miles north of Bombay near the Arabian Sea coast. Indications of oil were found at about 3,000 feet in marine sediments in a wildcat well located five miles northwest of Cambay.

A test projected to 10,000 feet was spudded on July 25 with a Russian rig utilizing a downhole drilling turbine. Drilling was interrupted September 3 for electrical logging. Oil shows were noticed in the mud while circulating. Bottomhole pressure was reported at 2,800 psi, as compared to normal hydrostatic head of 1,360 psi for the depth reported.

Elsewhere, the Indian government's wildcat at Jwalamukhi in the Himalaya Mountain foothills had been shut down during most of the first half of 1958 because of a fishing job which required shipment of special tools from Russia. Gas was reported discovered above 6,000 feet. Another test was being drilled by the Indian government near Hoshiarpur.

Two Wildcats in Western Australia Find Oil Shows

West Australian Petroleum Pty. Ltd. (WAPET) encountered oil shows in two tests in the Kimberleys, 200 miles apart at Meda 1 and Goldwyer 1. Meda is about 40 miles east of Derby; Goldwyer, about 40 miles south-southeast of Broome.

Goldwyer 1, spudded on August 17, 1958 was drilled to 4,574 feet in basement after encountering non-commercial scattered oil shows in tight limestones from 2,900 to 4,013 feet. Meda 1 was drilled to 8,809 feet in basement after finding oil shows at 6,710 feet. WAPET intended to set pipe, acidize, and test these shows. In addition, a seismic crew was being moved to the Meda area for detail shooting.

Brazil Steps Up Drilling To Increase Production

Brazil's Petroleo Brasileiro, S. A. (Petrobras) was running about 56 rigs in early October, 1958, including 14 in Amazonas. The vigorous Amazonas exploratory work was supported by four separate groups dispersed in the jungles.

Petrobras was seeking to employ more drilling contractors, particularly for development work in Bahia, where only Petrobras owned rigs were drilling. Only U. S. drilling contractors had been engaged. Other foreign technicians were active in other types of exploratory work. Petrobras was seeking to bolster its advisory staff, particularly in drilling and production.

New contractors were being sought to provide as complete a turnkey deal as possible and to accept as high a portion of its payment in Brazilian currency as possible. Several new drilling contractors, including Loffland Brothers Company, were expected to enter Brazil.

New oil production found in Alagoas is encouraging. Petrobras expected to drill up to 30 wells annually in this area for several years. Over-all Brazilian crude production exceeded 50,000 barrels daily as of midyear 1958. Petrobras hoped to raise it to as much as 100,000 barrels daily, possibly by the end of the year.

Refining capacity was being expanded, with particular emphasis on new lube oil plants to enable Brazil to refine more domestic crude. Some is being exported because it is too highly paraffinic for complete utilization in domestic refineries.

The new Manaos Refinery in Amazonas was running at over-capacity of 5,700 barrels daily. It was expected that capacity would be boosted to 7,000 barrels daily by 1960 to fulfill expanding local products needs. Peruvian and Venezuelan crude were being run. It has been found somewhat cheaper to land Venezuelan crude at Manaos than crude from the Peruvian Oriente.

The transfer of the capital of Brazil to the interior at Brazilia will not affect Petrobras, whose headquarters will remain in Rio de Janeiro.

Walter Link, who heads Petrobras' exploration program, was expected to remain in his post after the term of his original five-year contract expires.

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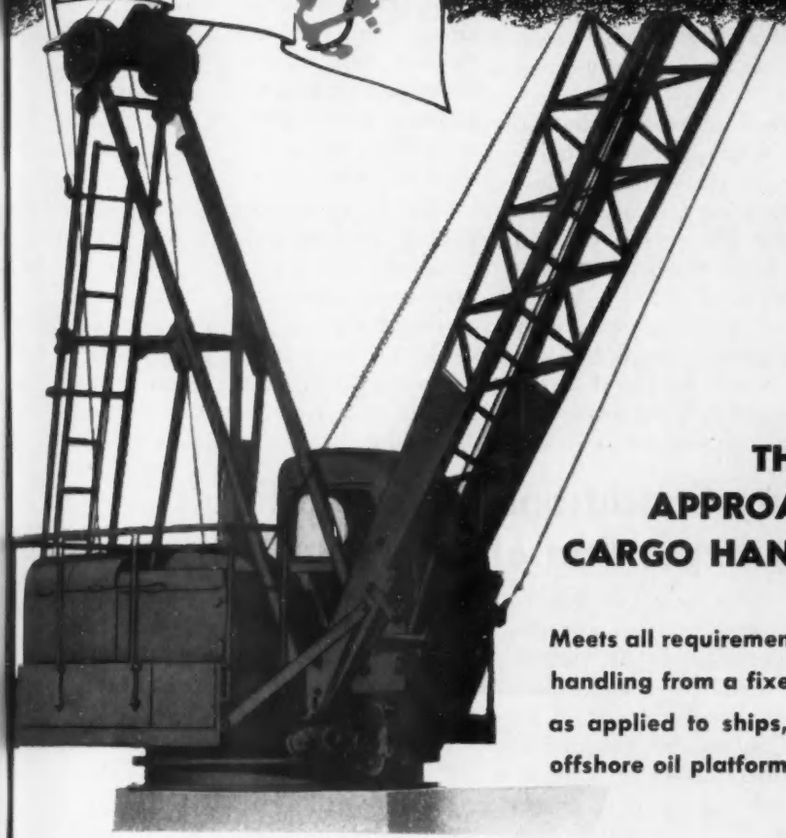

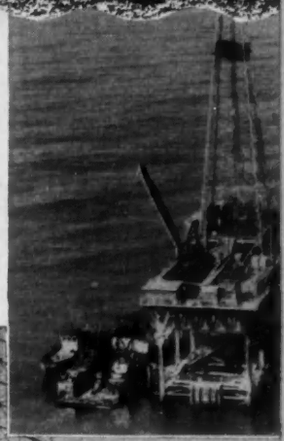

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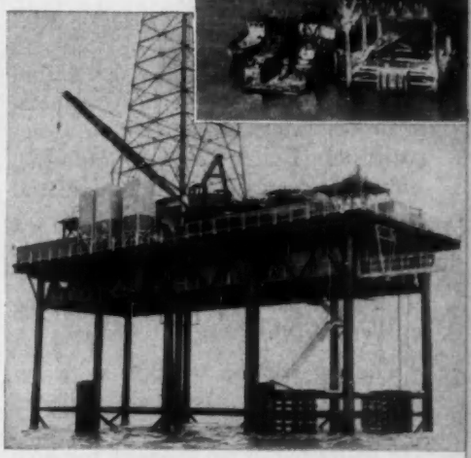

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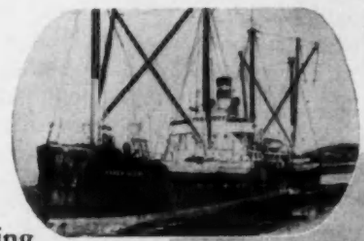

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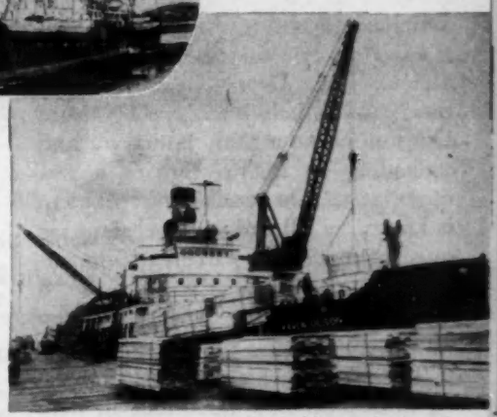

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Ohio to Air-Lift Rig Into Guatemalan Jungle for 13,000-Foot Wildcat Test

Ohio Oil Company of Guatemala is proceeding with plans to drill a 13,000 foot wildcat test on the Arruga Grande anticline in the jungles of Guatemala, Central America. It will be the first well to be drilled in the Guatemalan interior and the first wildcat drilled to any great depth anywhere in Guatemala.

The operator is a subsidiary of The Ohio Oil Company. Associated equally with Ohio Oil in the operation are Amerada Petroleum Corporation, Continental Oil Company, and Union Oil Company of California.

Ohio of Guatemala has let a contract for drilling the deep wildcat to Brown International Drilling Company, of Long Beach, California. Brown has agreed to purchase and assemble in Houston a $1 million, 1 million pound rig, and to fly it into the Guatemalan jungle. It will be one of the biggest air lifts of drilling equipment in oil industry history.

The rig will be shipped by water to Puerto Barrios, on the Caribbean coast of Guatemala. From there it will be loaded in packages of less than 16,000 pounds each aboard two giant C-82 Flying Boxcars and taken about 110 miles inland to the Peten area.

It is hoped that the wildcat can be spudded in by March 15, although the planned air lifting of rig, tools, materials, and supplies is something that has never been done before. The time table includes shipping from Houston no later than January 1 and unloading at Puerto Barrios a few days later. The packaging problem is knotty, as all units of the giant rig must be made into parcels with maximum dimensions of 7½ feet wide, 8 feet high, and 24 feet long. Also, there are weight limits.

The planes which will fly the big rig must land on a 4,000 foot air strip freshly chopped from a jungle cliffside. The crews of workmen already on the job for nearly a year preparing the strip and an accompanying jungle-piercing road, are working in the heart of ancient Mayan Indian country, amid forests of 200-foot mahogany trees.

Ruins of centuries-old Mayan cities dot the area where the planes will land. From that point, the packaged components of the drilling rig will be hauled along a crude and newly cut road for six miles to the well site at the edge of a jungle-bound promontory, 1,000 feet above the wilderness floor.

There, a crew of more than 100 native workmen have been busy hacking out a site for the wildcat drilling effort and preparing for cargo loads. The air freight will permit erection of a camp to house the drilling crews and their equipment.

The cost of airlifting the heavy drilling equipment and supplies will be high. But it will be less than the prohibitive cost of building roads over the rugged mountain terrain and through rain forests of 200 foot hardwood trees and dense jungle undergrowth. The airlift was considered the only economically feasible method of moving in the drilling equipment.

Such handicaps as annual rainfall of 200 inches a year will harass the crew, consisting of a toolpusher, mechanic, materials man, drillers, derrickmen and native rotary helpers.

Brown's manager will be quartered at the nearest populated area, Guatemala City, which is headquarters for the Ohio firm.

Guatemalan oil concessions, granted in 1956, have been the subject of vast exploration moves by all major oil companies sharing in the multiple grants. Following the exploratory work, the Ohio firm started working native crewmen on the landing strip and six mile road section leading to the drilling site.

Improving Conditions in Bolivia Point To Early Expansion of Oil Industry

Petroleum development in Bolivia is expected to increase. It has been encouraged by several important factors.

Bolivia has modified its petroleum laws to permit development of its promising oil resources by foreign companies. Numerous U. S. companies consequently have entered Bolivian exploration. U. S. companies also had an added incentive through the investment guaranty program of the U. S. government's International Cooperation Administration. It insures U. S. investments in Bolivia against expropriation and assures convertibility of profits and investments into dollars.

The political and economic situation has shown marked improvement. The current administration is backed by a great majority of the Bolivian people and is well regarded outside the country.

Companies that hold properties in Bolivia include: Gulf, Shell, Standard of Indiana, Standard of California, Pure Oil, Union Oil & Gas of Louisiana, Hancock, Murphy, Lion Oil, Tennessee Gas, White Eagle International, Drilling & Exploration, Bolivian American Oil Company and others.

These companies are now spending in Bolivia on exploration work over $20 million annually. For 1959-1960 the rate is expected to exceed $30 million.

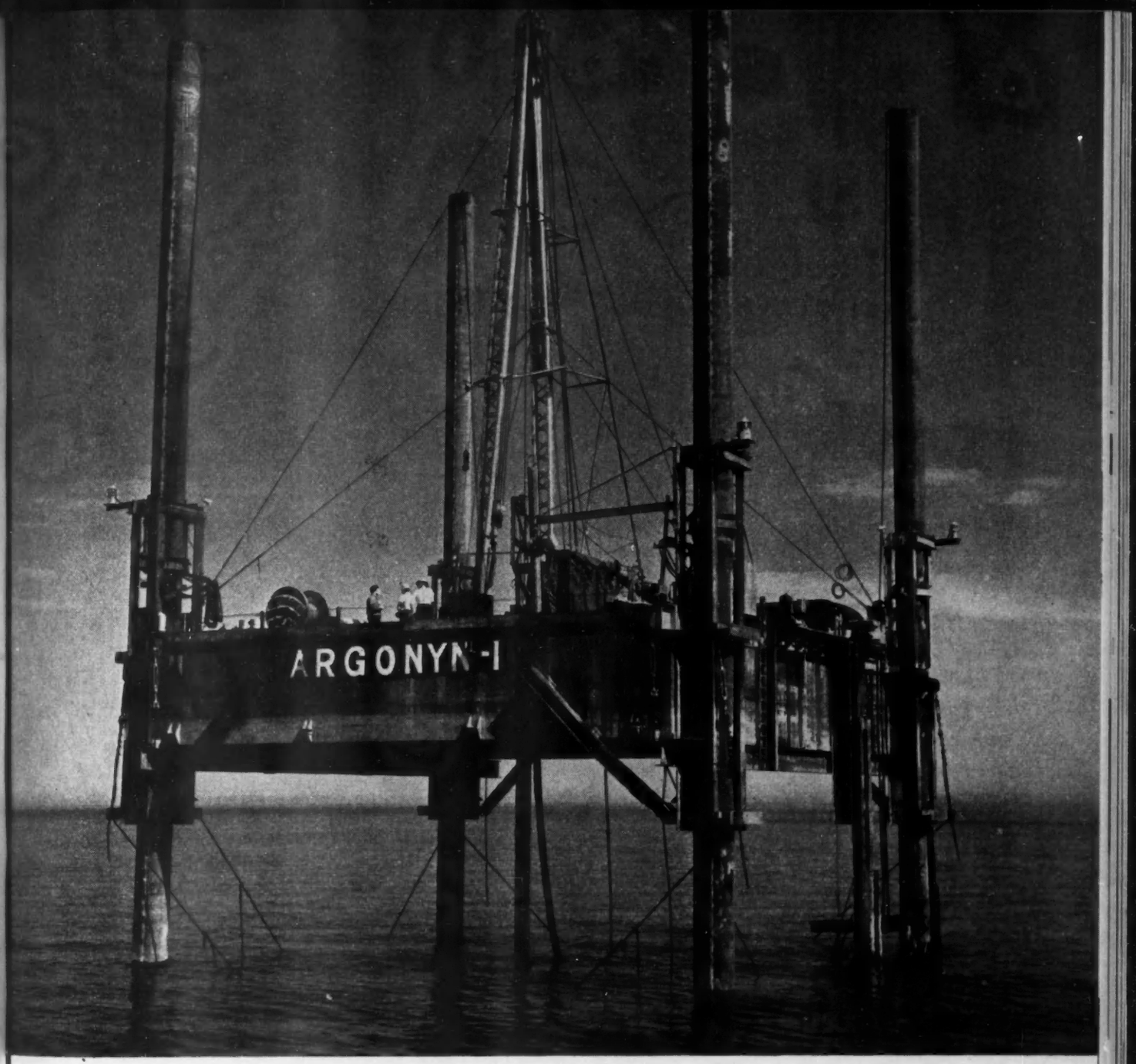
Proved reserves in Bolivia are conservatively estimated at 70 to 80 million barrels in six proved fields. Expert estimates of reserves in Madrejones field alone, one of the still undeveloped fields, run between 50 and 500 million barrels.

Bolivia's current crude oil production is averaging about 12,000 barrels daily. The country now has 765 miles of pipe line. A new pipe line is being built to Arica, Chile. It will provide Bolivia its first direct outlet to the sea. Additional pipe lines have been planned. They will extend to Paraguay, Argentina and an Atlantic port in Brazil.

Chile Is Hopeful for Oil In Northern Desert Region

Empressa Nacional del Petroleo (ENAP) reports encouraging results from preliminary exploration in the northern desert area. It hopes to establish a new oil province in the region. Additional seismograph work is planned. The company expects to drill its first well in Tarapacá Province by 1960.

ENAP had drilled a test below 10,000 feet in Cullen field on Tierra del Fuego recently. Volcanics were being encountered. But whether basement had been reached was questionable.



Drilling for Gas beneath Lake Erie. Seven-tenths of a mile off the Pennsylvania shore of Lake Erie, the Argonyn I was recently photographed drilling for gas with a powerful spudder. The Argonyn, owned by the New York State Natural Gas Corporation, is the first outfit to do offshore work on the American side of the lake. The job shown here was handled by Acme Drilling Co., which had been engaged by the rig-owner to sink the well.

At the time of the picture, the rig was set up in 35 ft of water. The cable-tool drilling line was Bethlehem 1-in. Type U, left lay; the sand line, 9/16-in. 6x7 right lay. To provide for depths expected before completion, the planning called for a later installation of ⅞-in. Type U drilling line, 7000 ft long.

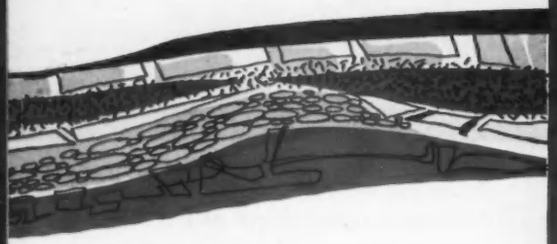
Bethlehem Steel Company, Bethlehem, Pa. On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

Mill depots and distributors from coast to coast stock Bethlehem rope for the following industries and numerous others:

PETROLEUM • CONSTRUCTION • EXCAVATING • MINING • QUARRYING • LOGGING • MANUFACTURING

IF YOU WANT MORE* THAN A GOOD CEMENT JOB...

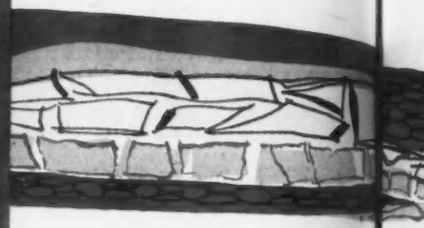
* *Casing on Bottom Safer and Faster*
* *Protection of Productivity*



...Specify *BAKER* PRIMARY CEMENTING EQUIPMENT

Baker Wall Scratchers

HINGE-LOK or SOLID-RING Models for all popular casing sizes.



Baker Casing Centralizers

HINGE-LOK or SOLID-RING Models with Multiple Ranges for all popular casing sizes.

Baker Fill-Up Equipment

DIFFERENTIAL Shoes and Collars for *any* well, and economical FLEXIFLOW Shoes and Collars for wells of *moderate* depth.

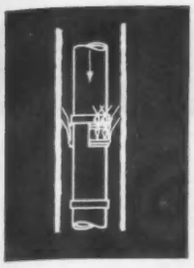


Fig. A

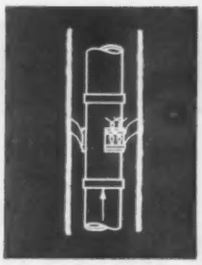


Fig. B

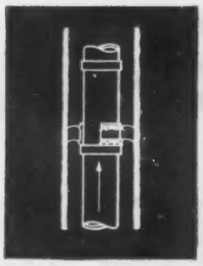


Fig. C

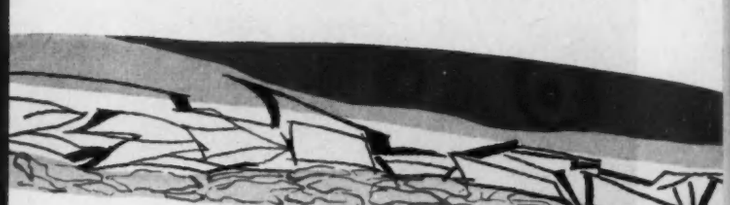
Fig. A Scratcher wires, retained by integral hinged mounting, swing freely upward and do not remove mud cake while running in.

Fig. B Even when casing is lifted out of the slips, the entire Scratcher remains stationary. Only when reciprocated, and

Fig. C ...only at the cementing area does the "scissors" action of the crossed wires remove mud cake.

Baker Scratchers remove mud cake only from the cementing area; this "controlled scratching" protects productivity.

While running in, the scratcher wires automatically swing upward along the casing, where they are safe from damage; permit free, unrestricted lowering of the casing; and do not disturb or remove mud cake. There is no danger of "balled-up" mud collecting on the scratcher wires to plug the annulus and contribute to pressure surges with possible "mudding-off" of the producing zone. Only when the cementing area is reached and the casing is reciprocated do the double rows of strong "crossed" spring wires automatically reach out, dig in, and remove the mud cake with efficient "scissors" action.



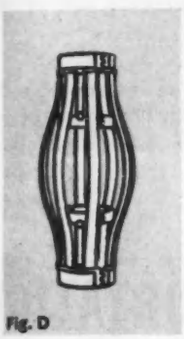


Fig. D

Fig. E

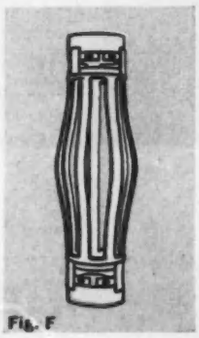


Fig. F

Fig. D "Extended" Range HINGE-LOK Baker H-25 Casing Centralizer. Product No. 9113.

Fig. E "Normal" Range HINGE-LOK Baker H-20 Casing Centralizer, Product No. 9112.

Fig. F "Slim Hole" SOLID-RING Baker G-15 Casing Centralizer, Product No. 910-G.

Baker Centralizers assure cementing clearance. "No-scrape" design prevents "balling", plugged annulus and stuck casing.

The QUALITY of Baker Casing Centralizers starts with "sled-runner" springs made of high quality spring steel—tested and pre-set by flattening in hydraulic presses—then butt-welded to collars to form a unit of great strength. Pre-setting of the springs to the pre-calculated optimum bowed height enables each centralizer to pass tight spots or dog legs without damage to the assembly, and ensures GREATER CENTERING FORCE for maintaining annular clearance for cementing.

Baker Centralizers do not remove mud cake which could plug the annulus, contribute to pressure surges and restrict productivity.

BAKER OIL TOOLS, INC.

Houston • Los Angeles • New York

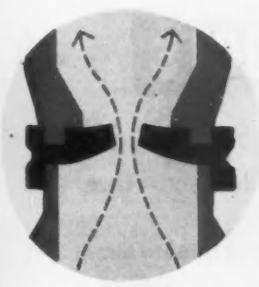


Fig. G

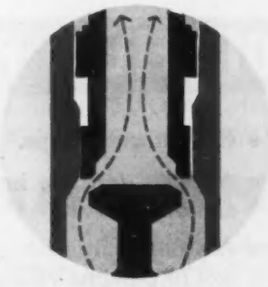


Fig. H

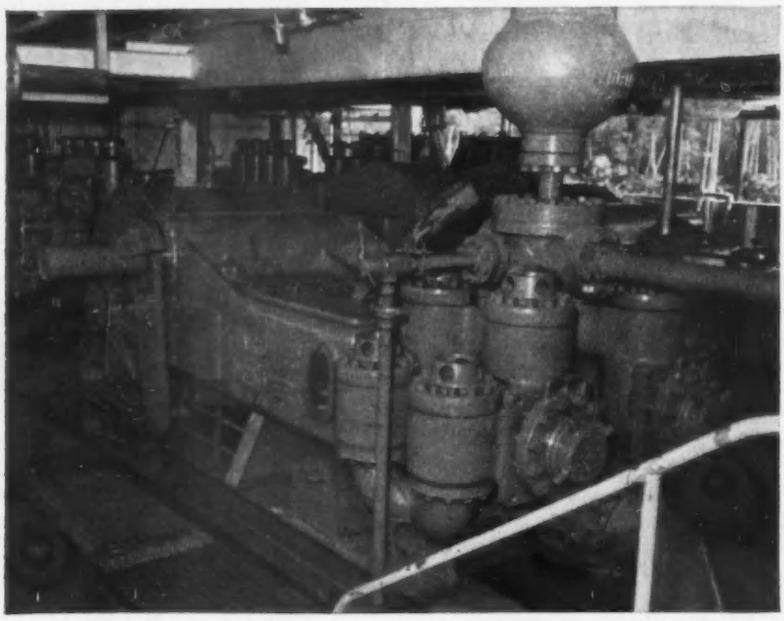
Fig. G Variable FILL-UP Valve as used in FLEXIFLOW Equipment.

Fig. H Variable FILL-UP Valve as used in DIFFERENTIAL Equipment.

Baker Fill-Up Equipment saves time in running casing, but does not create pressure surges that reduce productivity.

Destructive pressure surges—often created when casing equipped with conventional floating equipment is lowered into the well—can now be avoided. The Variable Valve in either Baker DIFFERENTIAL or Baker FLEXI-FLOW "Fill-up" Shoes and Collars, permits casing to fill from the bottom up; eliminates expensive, time-consuming surface filling; and automatically coordinates the *rate of fill* with the *rate of lowering* to AVOID high pressure surges. Baker FILL-UP Equipment permits the casing to be lowered at normal rates, saving rig time and reducing danger of sticking the pipe; chances for successful primary cementing are increased; formations are protected from high pressure surges which can impair their productivity.

GARDNER-DENVER



FOR DRILLING

Power mud pumps designed for heavy-duty loads at every drilling depth:

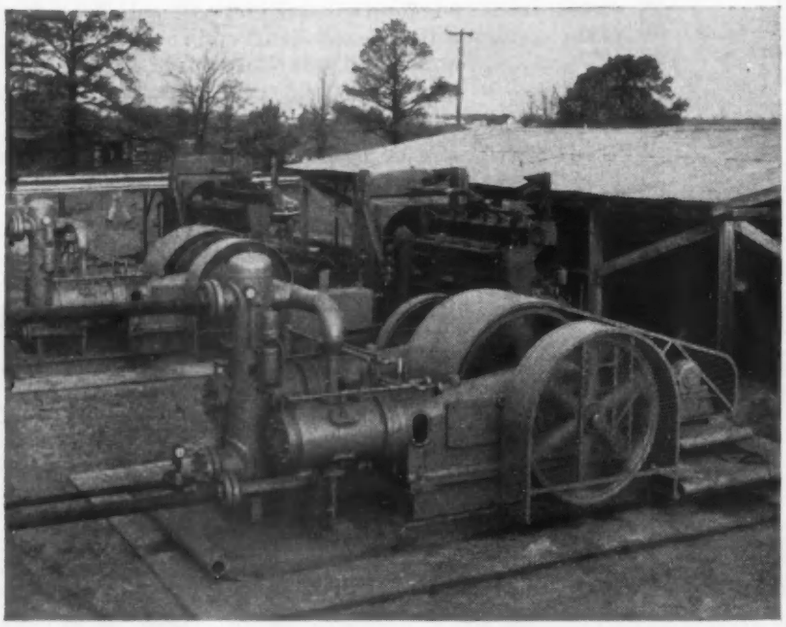
GXH 1250 hp.	GXR 1000 hp.
GXP 625 hp.	GXN 500 hp.
GXQ 350 hp.	FK-FXK 255 hp.
FZ-FXZ 185 hp.	FO-FXO 122 hp.

Quality mud pump parts.

Water-cooled compressors for air drilling and mud aeration.

Air compressors for powering rig equipment, engine starting and general service.

GX mud pumps for offshore drilling rigs. Eccentric construction keeps bearing pressures low. Counterbalanced crankshaft.



FOR TRANSPORTATION

Gas booster compressors . . . in capacities and pressures to meet service requirements.

Power pumps for gathering, transmission.

High-pressure pipeline testing compressors.

"Quadril"* . . . multiple rock drill rig equipped with remote-hydraulic controls.

"TWINDRIL"® . . . provides twin drilling power for short stretches of rocky trench.

Drill steel . . . carburized and shot-peened.

Five models of rotary portables:
RP900 RP600 RP365 RP210 RP125

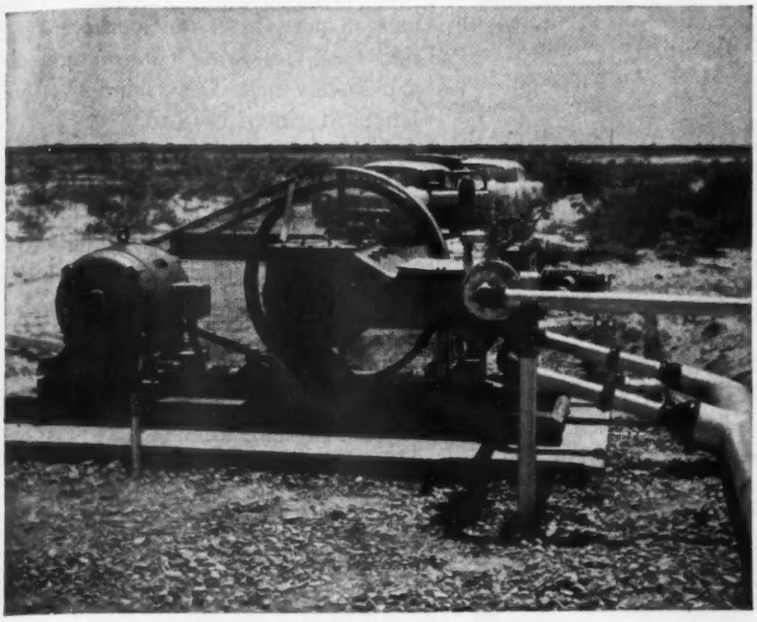
*Trade-Mark

Gardner-Denver RX gas booster compressor with combination cooler keeps pressure up; engine, compressor and gas cool.

OTHER GARDNER-DENVER OIL FIELD PRODUCTS

- Duplex steam pumps.
- Pumps and compressors for seismograph rigs.
- New Gardner-Denver "Mole-Dril"* for drilling shot holes.
- Centrifugal pumps.
- Air hoists, drills, impact wrenches and other air tools.
- Air motors for such applications as remote control of pipeline valves.

A GREAT NAME IN THE OIL FIELDS



FOR PRODUCING

The most complete line of quality power pumps for waterflood and salt water disposal:

PL-7 six-cylinder plunger—240 hp.

PA-8 triplex plunger—160 hp.

PE-5 triplex plunger—75 hp.

PG-3 triplex plunger—30 hp.

FG-FXG duplex piston—60 hp.

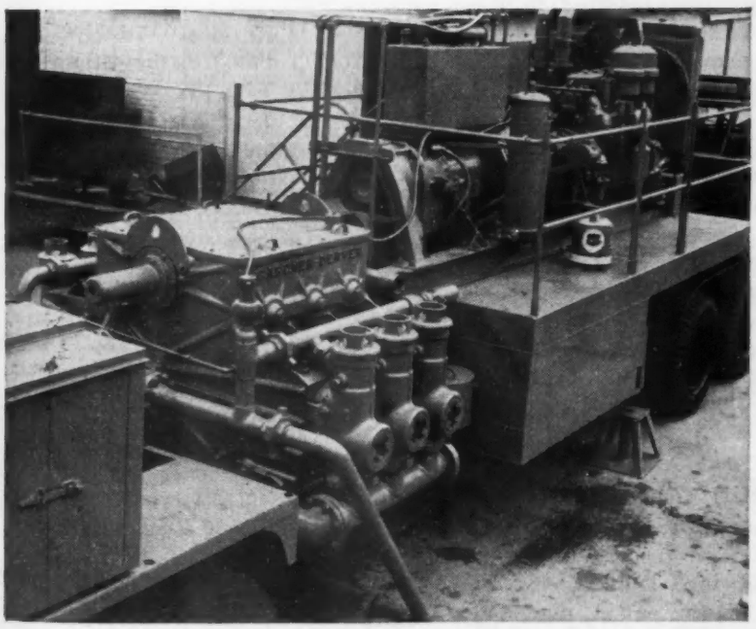
FF-FXF duplex piston—40 hp.

LE-LXE duplex piston—24 hp.

Repressuring compressors.

Air-gas lift compressors.

Gardner-Denver PG-3 has built-in reserve strength for continuous waterflooding operations . . . offers a wide range of capacities and pressures.



FOR WELL SERVICING

High-pressure pumps for cementing, acidizing, fracturing, and work-over service:

PL-7 six-cylinder plunger pump for squeeze pressure pumping to 10,000 psi.

PA-8 triplex plunger pump for high-pressure pumping to 8000 psi.

PE-5 triplex plunger pump for high-pressure pumping to 6000 psi.

The compact design of the Gardner-Denver PL-7 triplex plunger pump makes this high-pressure well servicing pump easy to mount on truck.

Pump and compressor service specialists located throughout the oil fields.

ENGINEERING FORESIGHT—PROVED ON THE JOB
IN GENERAL INDUSTRY, CONSTRUCTION, PETROLEUM AND MINING

GARDNER-DENVER

Gardner-Denver Company, Quincy, Illinois
In Canada: Gardner-Denver Company (Canada), Ltd., 14 Curity Avenue, Toronto 16, Ontario
Gardner-Denver Export Division, 233 Broadway, New York, N. Y.
Oil Field Offices: Dallas, Houston, Tulsa, St. Louis, Los Angeles, New York, Pittsburgh, Denver, New Orleans, Durango, San Francisco, Kansas City, Winnipeg, Edmonton

Texas Company Expanding Operations in Trinidad

In the two years since The Texas Company bought Trinidad Oil Company, crude oil production has been raised from 30,000 to 50,000 barrels daily.

Trinidad Oil Company's Pointe-a-Pierre Refinery throughput has risen from 75,000 to 125,000 barrels daily during the same period. The Texas Company is considering a $20 million expansion program that would double the capacity of this refinery.

Socony Will Seek Oil in French Equatorial Africa

Exploration and development of oil resources in Gabon and Middle Congo, French Equatorial Africa, is planned. The work will be done jointly by U. S. and French interests.

A joint operating agreement covering 6,175,000 acres has been signed, subject to governmental approval, by two Socony Mobil Oil Company affiliates and the French company. The Socony affiliates are Mobil Oil Fransaise and Mobil Exploration West Africa, Inc. The French company is Societe Des Petroles D'Afrique Equatoriale Francaise (SPAEF).

Costs of exploration and development, and of any production, will be divided 50 percent to SPAEF and 25 percent each to Mobil Oil Francaise and Mobil Exploration.

Second Field Discovered In Libya by Oasis Oil

A second oil field discovery in Libya, North Africa, has been made by Oasis Oil Company of Libya. Its Dahra Bl-32 drill stem tested 38 barrels of 36 gravity oil with no water in 1¼ hours from limestone at 3758-3808 feet.

The well is 100 miles south of the Gulf of Sirte and 24 miles south of the company's first Libyan discovery, Bahi 1. That well tested 75 barrels of 39 gravity oil in 2½ hours in late June from 32 feet of sandstone at 5,822 to 5,854 feet.

Oasis Oil, subsidiary of The Ohio Oil Company, is operator of 62 million acres of concessions in Libya, held in equal shares by Ohio, Amerada Petroleum Corporation, and Continental Oil Company.

a WORLD of OIL

AUSTRIA: Seismic work is being done by a contract party in the Scheibbs area, Lower Austria, in a 50-50 joint venture of British Petroleum Company and O.M.V., Austrian state oil administration. The venture involves 500,000 acres in two concessions in the Scheibbs and Amstetten areas.

BOLIVIA: Bolivian Gulf's first wildcat test in the country, at Mandeyapecu, was drilling below 11,000 feet in October, 1958.

DUTCH GUIANA: Control of concessions on 14 million acres, including offshore lands, in Dutch Guiana has been acquired by Gulf States Land & Industries, Inc. That company, controlled by Webb & Knapp, Inc., New York, acquired 80 percent of the capital stock of Colmar Surinam Oil Company, Ltd., which holds the concessions.

EAST AFRICA: Frobisher Ltd., a Canadian firm, was reported to have received exclusive exploration licenses of 8,000 square miles in Kenya and 70,000 square miles in Somalia.

FRANCE: Societe des Petroles de Valence was drilling below 5,000 feet in October in its first deep test in southwestern France, located near St. Julien-en-Born near the Atlantic coast. In southeast France in the Lyons area, two tests were being drilled on the Voiron permit, Brezins 1 which had reached 6,000 feet, and Beauregard-Baret 1 which reached 6,500 feet of depth.

GAUTEMALA: Government was reported planning a widespread development program to speed exploitation of Peten province. Exemptions of import taxes on equipment, machinery, and material imported by firms doing business in this province are granted by proposed legislation. Timber resources are particularly earmarked for development. New highway is planned to connect provincial capital of Flores with Caribbean ports.

HAITI: Commonwealth Oil Company was preparing to drill its first wildcat test on the mainland of Haiti in the fall of 1958.

IRAN: Vigorous concessions bidding activity was reported in Iran for submerged portions of the southern Persian Gulf, following confirmation of a discovery near Das Island by Abu Dhabi Marine Areas Ltd.

ISRAEL: Pyramid Oil Company planned to conduct at least six months of seismograph work in Israel. The company has varied financial backing, including a Denver, Colorado, independent. Pyramid has applied for concessions, and was negotiating for farmouts to drill in the Dead Sea area.

LIBERIA: Exploration operations on a 1½ million acre concession area in Liberia will be started by next spring by American-Liberian Exploration Company. The firm is headed by Richard H. Robinson, Oklahoma City.

MEXICO: Midyear 1960 is target completion date for a $40 million, 500 mile, 300 Mmcf daily natural gas pipe line from Tabasco in the Isthmus to Mexico City.

NEUTRAL ZONE: Arabian Oil Company, the Japanese combine, expects to commence from 3 to 5 wildcat wells during 1959 in the Saudi Arabia-Kuwait Neutral Zone offshore area of the Persian Gulf.

NEW ZEALAND: Shell-B.P.-Todd Oil Services expects to spud a wildcat on the west coast of North Island, 11 miles from Hawera. Drilling equipment was being shipped from Borneo for arrival in New Zealand in mid-October.

SENEGAL: Societe des Petroles du Senegal was drilling below 9,000 feet in October on Balandine I. A BP Exploration Company rig was being used. SPS had three seismic crews working the north part of its permit.

VENEZUELA: Discovery in Gulf of Paria by Paria Operations Inc. was described as an excellent producer rated at least at 2,000 barrels of crude oil per day.

WHO'S MEETING WHERE

DEC. 5	ASME, Annual Meeting, New York City, Statler & Sheraton-McAlpin Hotels.
9–10	Petroleum and Chemical Industry Short Courses, Credit Management for the Petroleum Equipment and Service Industry, The University of Oklahoma, Downtown University Center, Lockett Hotel, Norman, Okla.
1959 FEB. 2–27	Southwestern Legal Foundation, Short Course on Oil and Gas Law, Southwestern Legal Center, Dallas.
11–13	Southwestern Legal Foundation, 10th annual Institute on the Law of Oil, Gas and Taxation, Southwestern Legal Center, Dallas.
15–19	AIME, Annual Meeting, San Francisco, Hotels St. Francis, Sheraton-Palace, Sir Francis Drake.
24–25	Geological Symposium, The University of Oklahoma, Norman, Okla.
MAR. 4– 6	API Division of Production, Southwestern District, Scharbauer Hotel, Midland, Texas.
17–21	NACE, National Meeting, Civic Auditorium, San Francisco.
25–27	API Division of Production, Southern district, Roosevelt Hotel, New Orleans.
31– Apr. 2	Power Conference, Illinois Institute of Technology, 21st American Power Conference, Hotel Sherman, Chicago.
APRIL 5– 9	Nuclear Congress, Engineers Joint Council, Cleveland, Ohio.
8–10	API Division of Production, Eastern District, Spring Semi-Annual Meeting, Penn-Sheraton Hotel, Pittsburgh, Penn.
20–24	Petroleum & Chemical Industry Short Courses, Safety Engineering, University Downtown Center, Lockett Hotel, the University of Oklahoma, Norman, Oklahoma.
22–24	API Mid-Continent District Meeting, Herring Hotel, Amarillo, Texas.
26–28	TIPRO, 14th Annual Meeting, Baker Hotel, Dallas.
27–28	Petroleum & Chemical Industry Short Courses, Automatic Control, Oklahoma Memorial Union Building, University of Oklahoma, Norman, Okla.
30– May 1	API Division of Production, Pacific Coast district, Biltmore Hotel, Los Angeles.

Nomads' Chapter monthly meeting: Los Angeles, second Wednesday, Jonathan Club, Wallace A. Sawdon, Secretary. Houston, second Monday, Ye Old College Inn, Harry E. Estes, Secretary. Dallas-Fort Worth, first Monday, Greater Dallas Club, Hank Davis, Secretary. Tulsa, Hotel Tulsa, Gilbert Swift, Secretary. New York, first Monday, Hotel Biltmore, Jesse E. Hickman, Secretary.

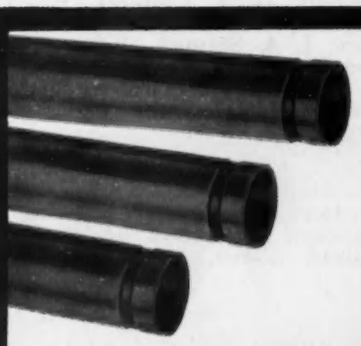
CUT COSTS WITH THE NEW

VIC-EASY®

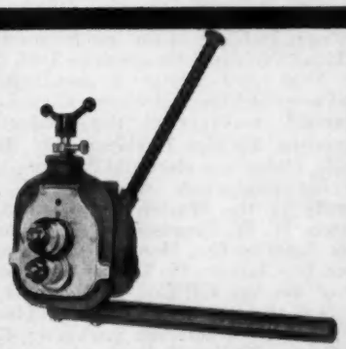
METHOD OF JOINTING LIGHTWEIGHT PIPE

SAVE UP TO 60% IN PIPING COSTS!

Now there's no need to buy overweight pipe. Thanks to Victaulic engineering, you can select lightweight pipe "job-rated" to your conditions and install it the *new VIC-EASY way*. You'll cut costs of pipe, transportation, and handling —you'll save from 30% to 60% in man-hour installation.



1. LIGHTWEIGHT PIPE in thicknesses from .065" handles high pressures. Leading mills make sizes 1¼" to 12", steel or aluminum, with *VIC-EASY roll-grooved ends.*



2. VIC-EASY PORTABLE GROOVER rolls grooves into pipe in seconds. Manually or power-operated, this groover removes no metal...retains full wall thickness.

3. VICTAULIC SNAP-JOINT COUPLING assembles and locks by hand—no wrenches or tools required. Other bolted styles of Victaulic Couplings alternately usable.

4. VICTAULIC FULL-FLOW FITTINGS team up with our couplings and lightweight pipe to provide a *complete VIC-EASY system*...cuts costs of installation *and* operation.

For complete information write for Bulletin GG12

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For more data on advertised products, use Readers' Service Cards, last page.

What's Happening

among MEN in the INDUSTRY

H. S. M. Burns

Frank Porter

H. S. M. Burns and **Frank M. Porter** were re-elected chairman of the board and president, respectively, of the **American Petroleum Institute** at the annual meeting in Chicago. Burns is President of **Shell Oil**, New York, and Porter is president of **Fain-Porter Drilling**, Oklahoma City. **L. E. Fitzjarrald**, manager of the production department, **Phillips Petroleum Co.**, Bartlesville, Okla., was elected API vice president for production, succeeding **D. L. Connelly** of the **Warren Petroleum Co.**, Houston. **H. W. Ferguson** of the **Humble Oil & Refining Co., Houston**, will be succeeded by **Clarence H. Thaver**, vice president of the **Sun Oil Co.**, Philadelphia, as vice president for refining. **C. J. Guzzo**, vice president of domestic marketing, **Gulf Oil Corp., Pittsburgh**, was elected vice president for marketing. He succeeds **D. T. Colley** of The **Atlantic Refining Co.**, Philadelphia. **C. E. Spahr**, president of the **Sinclair Oil Corp., New York**, was re-re-elected API vice president for transportation. **P. C. Spencer**, chairman of the **Sinclair Oil Corp., New York**, was re-elected treasurer and **Willard N. Wilson** of the **API**, New York, was renamed secretary.

Gerald McGrew was elected president of **Cities Service Oil Co. (Del.)**. McGrew steps into the vice presidency from managership of the company's Crude Oil Supply division.

Delhi-Taylor Oil Corporation has recently announced organizational changes at the management level. The former duties of **P. T. Bee**, who has resigned as executive vice president to accept a management position with Murchison Brothers, will be divided among Delhi-Taylor executives. Company President **James L. Sewell** will take over part of Bee's general management functions. **C. H. Hobbs** has been appointed to the newly-created position of executive assistant to the president. He will continue as corporate secretary. **G. B. Linter** was appointed controller in addition to his present treasurer's position. **W. C. Smith**, vice president of production, will coordinate activities of the Geological, Land and Geophysical departments in the Exploration division. Dallas will become headquarters for all of Delhi-Taylor's executives. **Fred P. Sewell**, vice president of manufacturing and marketing, will move his office to Dallas from Corpus Christi, Texas.

Shell Oil Company's Lafayette, La., Production division officially began operation September 1 after its staff occupied the new two-story Shell Building in the Oil Center. The new division was formed by consolidating the Lake Charles and Franklin Production divisions. **A. C. Dahl**, former manager of the Lake Charles division, is manager of the new division. The division staff is composed of **L. C. Becker**, and **C. E. DeWitt**, production superintendents; **G. S. Kukuchek**, mechanical engineer; **F. G. Phillips**, exploitation engineer; **J. A. Shattuck**, drilling foreman; and **Keith Doig**, gas superintendent. **M. E. Ohsfeldt** is office supervisor, and **R. A. Todd** is purchasing-stores supervisor.

W. Joseph Straus was elected to the board of directors of **Britalta Petroleums, Ltd.**, Canadian independent oil company of Calgary, Alberta, Canada.

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Jack Enen

Haylett O'Neill has been named purchasing agent at **Humble Oil & Refining Company.** He has been with Humble since 1934 and has been serving as assistant purchasing agent since 1955. O'Neill replaces retiring **Francis T. Fendley.**

Frank Lindeman, Jr., has been elected executive vice president of **United Producing Company, Inc.** Lindeman also was chosen a director of the company and of two other United Carbon subsidiaries, **United Carbon Company, Inc.**, and **United Rubber & Chemical Company. H. E. Norrick**, who has been associated with the growth of United Carbon since its formation in 1925, was elected senior vice president of United Producing. Two other United Producing vice presidents were also chosen. They are **John M. Capito**, the company's Appalachian area gas and oil operations manager; and **Cramon Stanton**, manager of exploration.

Stekoll Petroleum Company's technical staff was expanded with the hiring of two engineers and two geologists. **Jack Hinckley, A. D. Barnes, Jr., James Urice** and **L. E. Buzarde, Jr.**, will aid Chief Engineer **Art Woerheide.**

Central-Del Rio Oils Limited announced two promotions within the company. **John W. Uibel** has been promoted from district engineer to chief engineer and **Kent Stoddard** was promoted from field engineer to district engineer.

Fred O. Sharp, Jr., has been named general manager of **D.D. Feldman Oil and Gas**, and executive vice president of **Worldwide Petroleum Corporation, Ltd. Harold N. Smoot** succeeds Sharp as executive assistant and coordinator, and **J. Lawrence Lee** is the new manager of the Primary Production department of both Feldman companies. The Secondary Recovery department has been placed under the supervision of **R. H. Angevine.**

Fred O. Sharp, Jr.

Roy H. Smith has been appointed chief petroleum engineer for **Pan American International Oil Co.** and has been assigned to the firm's New York office.

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L. Russell Marks was elected executive vice president of **Murphy Corporation.** He has been vice president-finance and service of Murphy Corporation since 1955 and formerly associated with C. H. Murphy, Sr., and members of his family in several business enterprises. **J. A. O'Connor, Jr.**, was elected vice president. He has been secretary and general counsel of Murphy Corporation since 1954.

M. D. (Dale) Myers has recently opened an office for **Geological Consultation.** The

ADDITIONAL DATA: Improved Cages

MARTIN RUBBER GUIDE CAGES

PAT. NO. 2,591,174

Metallic back-stop is now available in Closed Type Cages by use of 18-8 insert in upper part of rubber guide. Ball never touches this metal in normal pumping.

Metallic back-stop is now provided in Open Type Cages by leaving cross bar above primary ball stop position. Ball never touches this metal in normal pumping.

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Many production men specify MARTIN CAGES in all their pumps. Our cages are available in all sizes and types to take care of anyone's requirements.

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Manufacturer

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What's Happening

among MEN in the INDUSTRY

H. S. M. Burns

Frank Porter

H. S. M. Burns and **Frank M. Porter** were re-elected chairman of the board and president, respectively, of the **American Petroleum Institute** at the annual meeting in Chicago. Burns is President of **Shell Oil**, New York, and Porter is president of **Fain-Porter Drilling**, Oklahoma City. **L. E. Fitzjarrald**, manager of the production department, **Phillips Petroleum Co.**, Bartlesville, Okla., was elected API vice president for production, succeeding **D. L. Connelly** of the **Warren Petroleum Co.**, Houston. **H. W. Ferguson** of the **Humble Oil & Refining Co.**, Houston, will be succeeded by **Clarence H. Thaver**, vice president of the **Sun Oil Co.**, Philadelphia, as vice president for refining. **C. J. Guzzo**, vice president of domestic marketing, **Gulf Oil Corp.**, Pittsburgh, was elected vice president for marketing. He succeeds **D. T. Colley** of The **Atlantic Refining Co.**, Philadelphia. **C. E. Spahr**, president of the **Sinclair Oil Corp.**, New York, was re-elected API vice president for transportation. **P. C. Spencer**, chairman of the **Sinclair Oil Corp.**, New York, was re-elected treasurer and **Willard N. Wilson** of the **API**, New York, was renamed secretary.

Gerald McGrew was elected president of **Cities Service Oil Co. (Del.)**. McGrew steps into the vice presidency from managership of the company's Crude Oil Supply division.

Delhi-Taylor Oil Corporation has recently announced organizational changes at the management level. The former duties of **P. T. Bee**, who has resigned as executive vice president to accept a management position with Murchison Brothers, will be divided among Delhi-Taylor executives. Company President **James L. Sewell** will take over part of Bee's general management functions. **C. H. Hobbs** has been appointed to the newly-created position of executive assistant to the president. He will continue as corporate secretary. **G. B. Linter** was appointed controller in addition to his present treasurer's position. **W. C. Smith**, vice president of production, will coordinate activities of the Geological, Land and Geophysical departments in the Exploration division. Dallas will become headquarters for all of Delhi-Taylor's executives. **Fred P. Sewell**, vice president of manufacturing and marketing, will move his office to Dallas from Corpus Christi, Texas.

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petroleum geologist also will be concerned with exploration, evaluation, development and supervision.

C. J. Gudim, district geologist for **Sinclair Oil & Gas Company** at Casper, Wyo., has been promoted to staff geologist and transferred to Denver. **Donald W. Wiger,** senior geologist at Casper for the company, was promoted to district geologist replacing Gudim.

Canadian Husky Oil Ltd., announced that **John R. McNulty** has been named vice president, industrial relations, a new position in the company.

George W. Field has been appointed manager of exploration for **Cities Service Oil Co.'s** Southern division, succeeding **H. Ben Cox,** retired. Field has been succeeded by **Perry E. Barnhart** of Lafayette, La., as Southern division geologist.

The Shell Oil Company announced the reorganization of its production territories in the company's Houston area, which includes the eastern and southern portions of Texas. Under the new organization the East Texas and Houston divisions will be combined into a single unit with overall administrative headquarters in Houston. Kilgore will continue as a district production office with supervision of Shell's East Texas operations as in the past. **H. K. McKinnon,** currently East Texas division production manager in Kilgore, has been named manager of the consolidated unit. **J. W. Moore,** present Houston division production manager, will become production superintendent on the Houston area staff. There will be two division production superintendents in the new organization. **R. L. Walker,** now East Texas division mechanical engineer, will be production superintendent at Kilgore, and **C. H. Taylor,** now Houston division production superintendent, will continue in the same capacity.

Charles J. Bryce has reported to Venezuela headquarters of **Brown Drilling Company** and assumed charge of that operation. From headquarters in Maracaibo, Bryce will direct the entire Venezuelan operation for Brown, with such equipment at his disposal as a new super-powered rig shipped to the Latin nation early this year for drilling to the 15,000-foot level.

Charles J. Bryce

W. Joseph Straus was elected to the board of directors of **Britalta Petroleums, Ltd.,** Canadian independent oil company of Calgary, Alberta, Canada.

The British-American Oil Producing Company has appointed **W. E. Boyd** as district superintendent for the company's Southern district, replacing **Gordon J. Buckle.** The company's Southern district, with headquarters in Houston, includes southeast Texas, Louisiana, southeast Arkansas, Mississippi and Alabama.

Delhi-Taylor Oil Corporation has made two personnel changes in the Exploration division. **R. B. Gustafson, Jr.,** has been promoted from senior staff geologist to assistant chief geologist. He will supervise all of the district explorations supervisors in this country and will assist Chief Geologist **Norman C. Miller** in the technical phases of foreign exploration in a staff capacity.

Dr. William Schriever, University of Oklahoma professor, recognized as "Dean of Geophysics" in the state of Oklahoma, has been selected to honorary membership in the Society of Exploration Geophysicists. The award was presented at the national organization's annual meeting in San Antonio by **E. V. McCollum,** SEG president and former student of Dr. Schriever.

Austral Oil Exploration Company Incorporated has changed its name to **Austral Oil Company Incorporated** and will conduct oil exploration operations in 1959. The following executive changes have been announced. **Robert S. Moehlman,** executive vice president, director and member of the Executive committee has been appointed chairman of the Finance committees of both companies. **C. W. Leisk** has

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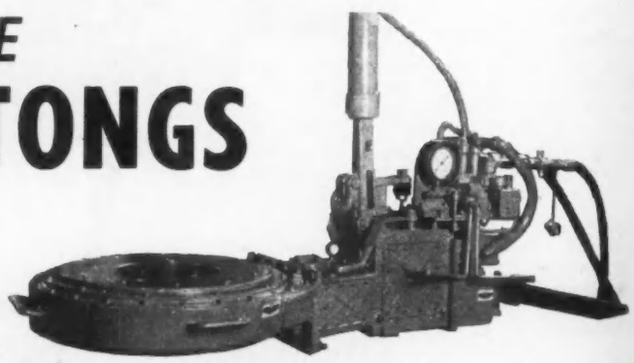

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Model No.	Size Range	Torque range in foot pounds
54	2⅜ to 7 inch	300 to 9,000
55	3½ to 10¾ inch	500 to 15,000
57	3½ to 10¾ inch	300 to 8,000
58	1½ to 5½ inch	300 to 4,000

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East-West Oil Tools, C. A.
Maracaibo & Anaco, Venezuela

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Design by Lycoming
35 HP; 274 pounds, dry

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Design by Lycoming
70 HP; 463 pounds, dry

No other industrial air-cooled engines pack the horsepower/pound of these two- and four-cylinder models. Modern design gives them 40-90% more HP per cubic inch displacement. Add to this high usable power, the economy of these engines . . . up to ⅓ in fuel savings over competitive engines . . . and you've got an unbeatable combination for your equipment power or power-unit applications.

The Hercules industrial air-cooled engines of Lycoming design have the dependability and endurance for which the Lycoming name is famous in aircraft engines. Crankshaft design is oversize and all bearings are of the replaceable type. With overhead valves, "top-overhaul" is fast and simple on these Hercules units; in fact, complete engine rebuild can be accomplished without removing the engine from its mountings.

Lubrication is by force-feed system with the oil fed from the crankcase to the engine's moving parts by gear-type pump through a pressure relief valve.

Available as engines or complete power-units, with accessory equipment to match service conditions, these engines have been refined by Hercules and are backed by Hercules reputation for quality, stamina and engineering excellence. Prompt service is available through Hercules world-wide distributor organization.

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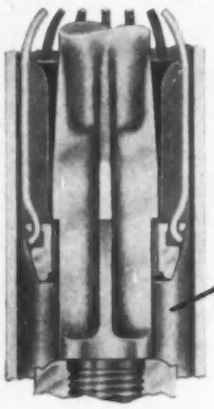

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been elected an executive vice president and a member of the board of directors and has been named a member of the Executive committees of both companies. He will have responsibility for the direction and administration of the Geological, Production, and Land and Legal departments of both companies. **Dr. James H. McGuirt,** vice president, continues as head of the Geological department of both companies.

J. Ed Warren

J. Ed Warren has been elected chairman of the executive committee and member of the board of directors of **Cities Service Co.** Warren resigned as senior vice president of the First National City Bank of New York, with which he has been associated since 1953.

William D. Blankenship, formerly geologist with Shell Oil Company at Denver, has joined **Wm. Ross Cabeen & Associates** as geologist in Cabeen's Manila office where he will assist **Charles Allen,** manager of Philippine operations. **Cornelius K. (Kim) Ham,** district geologist for Wm. Ross Cabeen & Associates at Los Angeles, has been transferred to the Cabeen organization in their continuing exploration project for Cerro de Pasco Petroleum Corporation. He will also aid in Cabeen's consulting practice in Peru and other South American countries.

Paul P. Powell has been named district production superintendent for the Oklahoma and Texas Panhandle areas by **Apache Oil Corp.**

W. S. S. Rodgers

W. S. S. Rodgers, former president and retired chairman of the board of directors of The Texas Company, was named as the 1958 recipient of the American Petroleum Institute's "Gold Medal for Distinguished Achievement."

Cities Service Oil Company has consolidated its South Texas production operations under the supervision of **D. S. Bodie** at Columbus, Texas, upon the retirement of **S. T. Duree.**

Continental Oil Company elected two new members to its board of directors. They are **Serge B. Jurenev,** assistant to the president and chief economist, and **Howard H. Hinson,** vice president and general manager of Continental's Foreign department.

Lloyd J. Beckman was elected secretary and a director of **Cities Service Oil Co. (Del.).** Beckman succeeds **F. B. Plank** who retired.

Ben C. Belt, a prominent figure in the petroleum industry, has been named to the board of directors of **Delhi-Taylor Oil Corporation.** Belt replaces **G. L. Rowsey,** who has resigned.

Bell & Burden, Inc., have announced a reorganization plan, and the following persons have been elected to executive office: **Joseph Burden,** president; **H. A. Buchanan,** executive vice president and secretary; **John Kerfoot,** vice president and treasurer; and **D. J. Murray,** assistant secretary. They also constitute the board of directors.

Ralph P. Latimer has been named asistant to the manager of production and exploration for the **Lion Oil Company** division of Monsanto Chemical Company.

John E. Roth was elected a director and senior vice president of **Tidewater Oil Company.**

I. Hayden Hughes was appointed general manager of **Pan American International Oil Company's** operations in Argentina. Hughes will depart shortly for Buenos Aires, where he will establish a headquarters office for Pan American International's Argentine operations. Hughes comes to Pan American International from Sunray Mid-Continent Corporation, where he was a vice president.

M. L. Hagan was appointed division manager of the Tulsa division of **American Climax Petroleum Corporation.** Hagan succeeds **L. L. Brundred** in this position.

Henry N. Toler, consulting geologist of Jackson, Miss., was appointed by **Governor J. P. Coleman** as a member of the Geological, Economic and Topographical Survey Board of the State of Mississippi for a five-year term.

Tioga Petroleum Corporation, a Delaware corporation, was formed for the express purpose of purchasing producing oil and gas properties in the United States and in foreign countries. Elected as directors of Tioga were the following Chicago business and industrial leaders: **John D. Ames,** partner, Bacon, Whipple & Company; **Lawrence Morrell Gross,** attorney; **John M. King,** partner, King-Stevenson Oil Company, an exploration company, and president of Kings-Stevenson Corporation, an oil and gas producing company; **Daniel F. McCarthy,** vice president, Charles Charlotte, Inc.; **Noel M. Seeburg,** attorney, vice president, N. Marshall Seeburg & Sons; **George M. Wallerich,** president, V. Mueller & Company, and **Robert Van Kampen,** president, Hitchcock Publishing Company. The following were elected to serve as officers of the corporation. King is president; Dixon, Jr., vice president, Land department; Stevenson, vice president, Production department; Seeburg, secretary; and Van Kampen, treasurer.

Denis B. Kemball-Cook, executive vice president in charge of exploration and production for **Shell Oil Company,** was elected to the board of directors of his firm.

New SERVCO JUNK MILL

chews up 9⅞" rock bit plus four extra cones *in 20 hours!*

Exclusive Servcoloy* process makes possible phenomenally-fast, smooth cutting action.

On this milling job two cones, a shank and two cones, and a complete bit were left in the bottom of the hole. After unsuccessful attempts to plug back and whipstock away from the fish a Servco Junk Mill was then run.

After 20 hours of milling the original bottom was reached. On running back with a bit and junk sub, the bit immediately made hole. When the worn bit and sub were pulled, approximately a half-cup of flattened ball bearings was recovered in the junk sub indicating complete milling up of the junk.

The success of Servco Junk Mills is primarily due to the unique Servcoloy* process. The mill is dressed with hundreds of carbide particles suspended in a tough, elastic matrix. As particles are worn or torn away, new cutting edges are automatically exposed. Hundreds of fresh cutting edges are always at work, enabling milling jobs to be completed in a fraction of the time formerly required.

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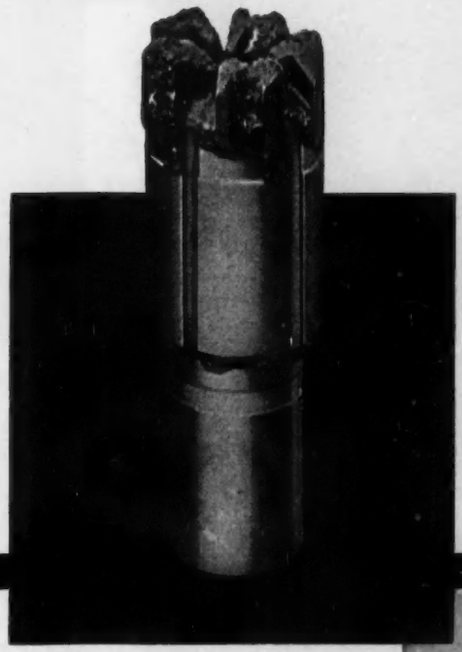

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Shale Bits—To fill the gap between rock and diamond drilling.
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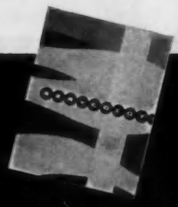

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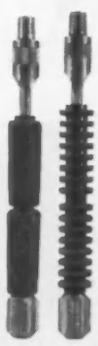

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L. F. McCollum Awarded Distinguished Service Award

L. F. McCollum, of Houston, president of Continental Oil Company (left) receives the Distinguished Service Award of the Texas Mid-Continent Oil and Gas Association for outstanding service to the oil industry during 1958 at the organization's annual meeting in Dallas. Presenting the award is Robert F. Windfohr, Fort Worth independent oil operator. Last year a national poll resulted in McCollum being named one of America's 50 foremost business leaders.

Harry L. Dedman has been elected an assistant vice president and appointed manager of the Oil department of **Texas Bank and Trust Company** of Dallas.

M. S. Johnson

Apache Oil Corp., has opened an exploration office in Denver. **M. S. Johnson,** formerly district geologist for Amerada Petroleum Corp. at Casper, Wyo., will head the office.

T. W. Koch, chief geologist of the Foreign department of Superior Oil Co. and **Leo van der Harst,** senior geologist with the same department, have left Superior to join **E. B. Noble** and **Lloyde H. Metzner** to form the consulting firm of **E. B. Noble** and **Associates** with headquarters in Los Angeles.

Becker, Davis & Pyle, Inc., is the name of a new company formed principally for the purpose of acquiring properties for secondary recovery operations. The owners, **Foster M. Pyle, William H. Davis** and **Merle Becker,** were formerly associated with D. D. Feldman Oil & Gas in the respective capacities of manager of production, manager of Secondary Recovery department and general manager.

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GLENDIVE, MONTANA—C. A. White...EM 5-3833
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Horne Well Service Co.....3-5396
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LAUREL, MISSISSIPPI
Assoc. Eng. & Equip. Co.....8-7588
LIBERAL, KANSAS
Rainbo Service .....Main 4-3598
LINDSAY, OKLAHOMA
Rainbo Service Co.....PL 6-2530
MIDLAND, TEXAS
Lucoous Service & Eqpt. Co.....MU 2-1631
OKLAHOMA CITY, OKLAHOMA
Rainbo Service Co.....ME 4-2131, ME 4-0105
VIDALIA, LOUISIANA
Davis-Kemp Tool Co., Inc.....435
WHITTIER, CALIFORNIA
Kline Wire Line Co.....OX 3-2731
WICHITA FALLS, TEXAS
Hudson-Eads, Inc. 322-8584

DEATHS

Burton Elias Hull, 74, well known pipe line builder, died in Dallas after a long illness. Hull was the builder of the Big Inch and Little Inch pipe lines during World War II, as well as the famous Tapline in Saudi Arabia after the war. He had been honored by governments, universities and by his own industry on innumerable occasions. He was known in the industry as "Mr. Pipeliner."

Roy M. Hunter, 71, consulting petroleum engineer and independent oil producer, died October 10 at his home in Tulsa. He was known as a prolific writer of historical and technical articles pertaining to the oil industry.

J. Norvelle Walker, 60, of Merion, Penn., president of the Royal Oil and Gas Corp., died October 9.

T. Blake Dirickson, 70, independent oil operator, died October 4 at his home in Tulsa.

Ben H. van der Linden, 78, first exploration and production chief of the Shell companies in this country and world-wide head of production activities for the Royal Dutch-Shell Group until his retirement in 1940, died October 5, while on a visit to Holland.

William Frank Buckley, 77, died October 5, in New York City. Buckley founded Pantepec Oil Company of Mexico in 1913 and a Venezuelan company by the same name in 1924. His other oil interests included companies searching for oil in Canada, Israel, Venezuela, Ecuador, Guatemala, Sicily, as well as in the U. S.

Cash M. Young, 76, retired independent oil operator, died September 9.

Lloyd G. Smith, 67, a retired vice president and director of Creole Petroleum Corporation, died September 9 at his home in Media, Penn.

Donald B. Wines, 57, former head geologist for **Midstates Oil Corporation** at Tulsa, died October 17, in Wichita, Kan.

Howard L. Bass, primarily an independent operator, died October 22, at his home in Rio Grande City, Texas.

Edwyn Clay Lloyd, 64, oil editor of the **Los Angeles Examiner,** died October 15.

Dr. William S. Crawford, 66, of Tulsa, retired medical director of **The Carter Oil Company,** died October 15 after a brief illness.

Harry E. Lillibrudge, 62 consulting geologist, Enid, Okla., died October 14, after a brief illness.

E. F. Blaise, 70, independent Oklahoma oil operator and one-time vice president of the **Inland Refining Company,** died October 11, at his home in Tulsa.

Walter Frederick Schmuck, 50, independent oil producer and lease broker, died September 10.

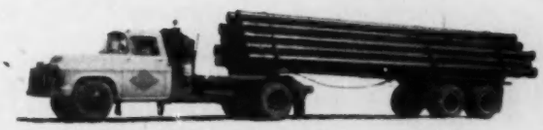
Congrats and $25 to Mr. D. J. SUGGS, Republic Natural Gas Co., Tipton Bldg., Pauls Valley, Okla., for this quip.

Joe Roughneck is top kick of the industry . . and plenty tough in his pipe demands.

He likes the plus factors he gets in using Lone Star electric weld pipe: convenient source of dependable supply, overnight delivery and rigid quality control through exacting multiple tests.

Sound, strong, lasting pipe you can depend upon: API casing, tubing and line pipe from Lone Star.

Neighbor, wherever you are, specify Lone Star and we both get a good deal.



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Lone Star STEEL COMPANY

EXECUTIVE—SALES OFFICES
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DISTRICT SALES OFFICES
912 Republic National Bank Building, Dallas, Texas
Houston, Texas | Midland, Texas | Tulsa, Oklahoma

what's Happening

among INDUSTRY ASSOCIATIONS

Newly Elected AAODC Officers

The American Association of Oilwell Drilling Contractors held their eighteenth annual meeting in Dallas recently and the following officers elected are, back row, left to right: Vice President for Cretaceous and Tertiary Basins, A. Earl White; Vice President of Offshore, W. W. Hawkins; Vice President for Illinois, Michigan, Indiana and Kentucky, Don Slape; Vice President for New Mexico and West Texas, H. Don Johnson; Vice President for Gulf Coast, Morris McDannald. Front row, left to right: National Vice President, George P. Livermore; President elect, J. Zeppa; Incumbent President, J. U. Teague; Executive Vice President, Brad Mills, and Secretary-Treasurer, W. L. McClusky.

Breitweiser Named as New OP Council President

Stanley D. Breitweiser, vice president of D-X Sunray Oil Company, was elected president of the new Oklahoma Petroleum Council for a full two-year term at the first meeting of the OPC Board of Directors in Tulsa.

F. C. Fellingham, Pan American Petroleum Corporation, was chosen vice president, and James O. Kemm, executive manager of the OPC, was elected secretary-treasurer. All three of the officers previously had been named by the OPC's executive committee to the same positions for a four-month interim term, ending December 31.

Approved by the directors was a field program for 1959 which includes a series of area meetings to be held throughout Oklahoma early in the year, to acquaint local oil men with the materials and services available from the OPC.

The directors approved the design of a membership card which will be furnished to all active workers in the OPC throughout the state. The card includes a drawing of the Drake well in Titusville, Penn., to help commemorate the oil industry's 100th anniversary, to be observed next year.

Oil Exploration Group Is Formed in Libya

The Petroleum Exploration Society of Libya recently has been organized in Tripoli. Officers for the year 1958 are president, Donald M. West, Mobil Oil of Canada, Limited; first vice president, J. Allen Sawyer, Esso Standard (Libya) Inc.; and second vice president, Jacque Canaple, Compagnie des Petroles Total (Libye).

Also secretary, Daniel K. Hamilton, American Overseas Petroleum Limited; treasurer, Alex Stoupnitsky, Compagnie Generale de Geophysique; director, Sam B. Frazier, Gulf Oil Company of Libya; director, Ronald C. MacLean, D'Arcy Exploration Co. (Africa) Limited.

Texas Mid-Continent Group Elects Three Vice Prexys

Texas Mid-Continent Oil & Gas Association named three new vice presidents to head district activities for the organization.

Elected at the closing session of the association's thirty-ninth annual meeting in Dallas were Vice Presidents E. J. Dunigan, Jr., Pampa, Texas, Panhandle district; Radcliffe Killam, Laredo, Texas, Lower Gulf Coast district; and John W. Mecom, Houston, Middle Gulf Coast district. All three are independent oil and gas producers.

Re-elected to second term as association president was Charles W. Alcorn, Houston, executive vice president, Falcon Seaboard Drilling Co. Also re-elected were Andrew M. Howsley, Albany, senior vice president and general counsel; Charles E. Simons, Dallas, executive vice president; and Eugene McElvaney, Dallas, treasurer.

Added to the board of directors were J. E. Connally, J. E. Connally Oil Co., Abilene, Texas; George B. Cree, Jr., Cree Drilling Co., Inc., Pampa; Earl C. Hankamer, Houston; H. T. Hilliard, Ashmun & Hilliard, Midland, Texas; H. B. Keck, The Superior Oil Co., Los Angeles; Eugene M. Locke, Locke, Locke, & Purnell, Dallas; Marvin L. McCullough, Rivercrest Oil Co., Inc., Wichita Falls, Texas; Ed Parkes, United Gas Pipe Line Co., Shreveport, La.; F. O. Penn, Tyler, Texas, and J. U. Teague, Columbian Drilling Co., Houston.

Re-elected as district vice presidents were J. Clyde Tomlinson, Longview, East Texas district; Wayne O. Watts, Wichita Falls, North Texas district; Joseph I. O'Neill, Jr., Midland, Permian Basin district; Waldo Wilson, Beaumont, Upper Gulf Coast district; Joseph S. Morris, San Antonio, Southwest Texas district; P. W. Pitzer, Jr., Breckenridge, West Central Texas district; and W. A. Landreth, Fort Worth, North Central Texas district.

Pacific Coast Exploration Societies Elect Officers

New officers were named by the Pacific Coast sections of American Association of Petroleum Geologists, Society of Exploration Geophysicists and Society of Economic Paleontologists and Mineralogists at the 35th annual convention in Los Angeles.

AAPG officers are: John T. (Jack) Isberg, Superior Oil Company, president; Irving T. Schwade, Richfield Oil Corporation, vice president; Paul H. Dudley, Jr., Humble Oil & Refining Company, secretary, and Harold L. Fothergil, Union Oil Company, treasurer.

SEG officers are: Robert B. Moran, Jr., Moran Instrument Company, president; John P. Gates, Western Gulf Oil Company, southern area vice president; W. P. Wilson, Western Gulf Oil Company, southern area vice president; Nolen A. Webb, Richfield Oil Corporation, secretary-treasurer, and T. L. Slaven, Western Geophysical Company, editor.

SEPM officers are: Charles W. Carey, Union Oil Company, president, and Alvin A. Almgren, Superior Oil Company, treasurer.

ASME Picks Glenn Warren; Other Officers Are Named

Glenn B. Warren, vice president and consulting engineer of the Turbine division, General Electric Company, has been elected president of The American Society of Mechanical Engineers for a one-year term.

Elected to serve with Warren were five vice presidents. They are Charles H. Coogan, Jr., head of the Mechanical Engineering department of the University of Connecticut; Gordon R. Hahn, assistant chief mechanical engineer for Gibbs and Hill, New York; John W. Little, president of the Goslin-Birmingham Manufacturing Company, Alabama; Thomas J. Dolan, head of the Department of Theoretical and Applied Mechanics at the University of Illinois; Harold Grasse, partner in Black and Veatch, Kansas City, Mo.

In addition, Arthur M. Perrin, president of National Conveyors Company, and Richard G. Folsom, president of Rensselaer Polytechnic Institute, were elected directors of the 50,000-member society for a four-year term.

$2000.00 SAVED ON A RECENT WELL

WITH A

JOHNSTON
Hydraulic
PUMPING UNIT

- The application was to pump 65 barrels a day from 8000 ft.
- He bought a 12-42 (12 foot stroke – No. 42 Power Unit) Johnston Hydraulic Pumping Unit—with 15,000 pound Polish-rod load.
- Operating at a maximum 3.9 strokes a minute, this unit produced the desired amount of oil, with the least wear on down-hole equipment.
- This Johnston Hydraulic Pumping Unit, including the Prime mover, weighed approximately 7100 pounds—one-third the weight of any mechanical unit to do the same job.
- And he saved more than $2000.00.

There's A

JOHNSTON
Hydraulic
PUMPING UNIT

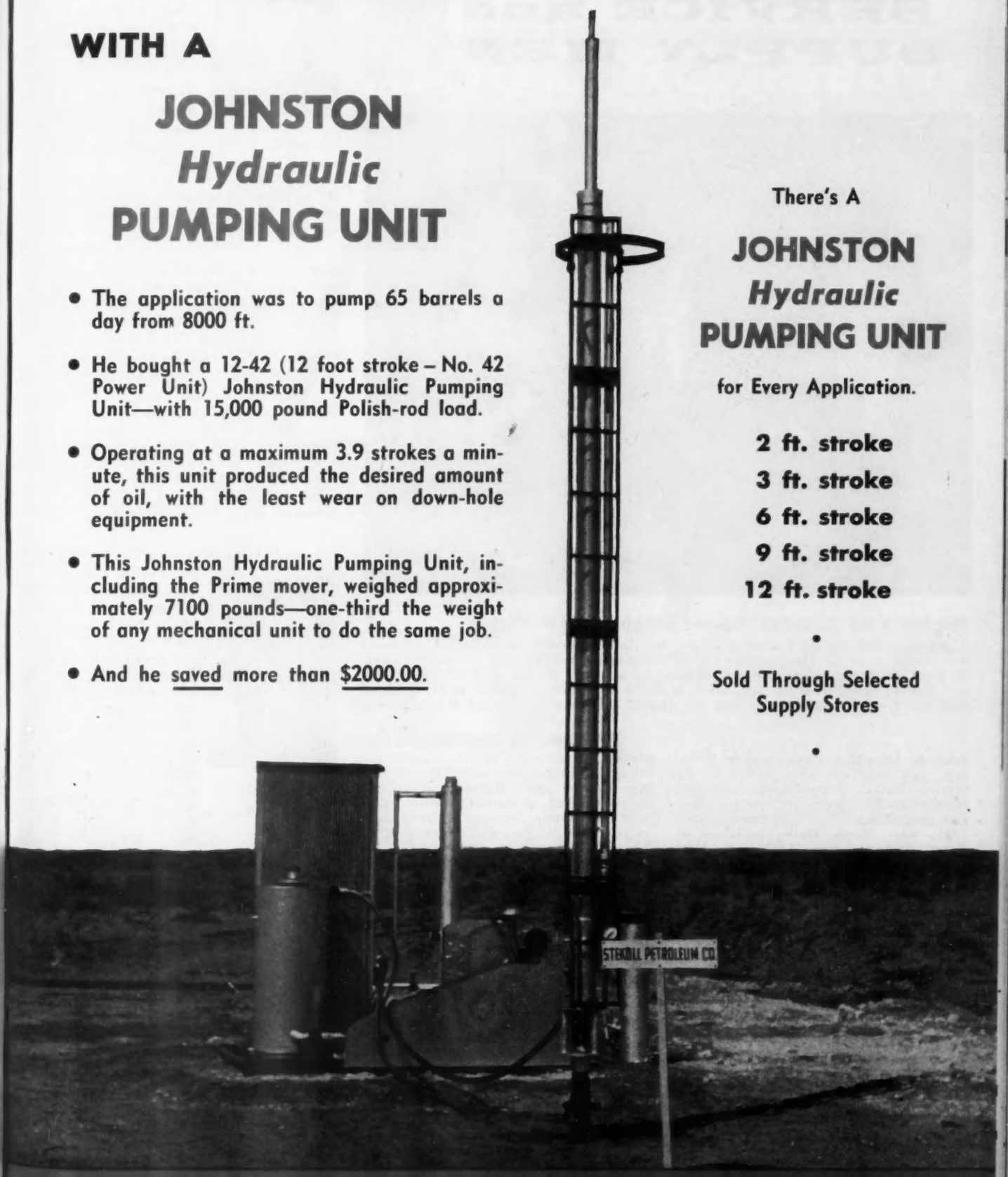
for Every Application.

2 ft. stroke
3 ft. stroke
6 ft. stroke
9 ft. stroke
12 ft. stroke

•

Sold Through Selected Supply Stores

•



ENGINEERED OIL TOOLS, INC.

P. O. BOX 1665 1710 BURNETT ST. — HOUSTON, TEXAS PHONE FA 3-0293

What's Happening among SERVICE and SUPPLY MEN

Hughes Tool Awarded Research Achievement Plaque

A plaque containing the resolution of the American Association of Oilwell Contractors was presented to the Hughes Tool Co. in Houston recently for that company's nearly 50 years of research devoted to the advancement of rotary drilling. J. U. Teague, (center) retiring president of the association, is shown presenting the plaque to M. E. Montrose, (left), vice president-sales, and Dr. Daniel J. Martin, vice president-engineering.

John B. Merritt has been named president and chief executive officer of **BJ Service, Inc.,** a **Borg-Warner** subsidiary. Merritt has been executive vice president and general manager of BJ Service since 1951. Also, **E. S. Dulin,** president of Byron Jackson since 1929, has been elected chairman of the board and **Andrew W. Rose** was named to succeed Dulin as president and chief executive officer. Rose has been vice president and assistant to the president since 1957.

Baroid Division National Lead Company recently announced several appointments and transfers within its Drilling Mud Department. **Kemp S. Lewis,** assistant manager of the Lower Texas Gulf Coast Area, has been transferred to Corpus Christi, Texas. **R. E. Killion,** formerly sales representative in Houston, has been appointed district superintendent at McAllen, Texas. **F. J. Wright,** service engineer, was appointed store manager at Edinburg, Texas; **W. W. Ames,** service engineer, was appointed store manager at Corpus Christi; **Jay Crist** has been employed as store manager at Jourdanton, Texas, and **June Wallace** employed as store manager at Tyler, Texas. In West Texas, **John T. Blaney, Jr.,** formerly district superintendent at Abilene has been appointed assistant area manager and will remain at Abilene. He is replaced as district superintendent by **Ed L. Easley,** formerly district superintendent at Wichita Falls, Texas. **J. D. Newsom,** district sales representative, replaces Easley as district superintendent at Wichita Falls.

In the Rocky Mountain area, Store Manager **E. A. Fine, Jr.,** has been appointed district superintendent with headquarters in Williston, N. D., and **F. M. Estep** appointed district sales representative with headquarters at Billings, Mont. In the Louisiana Gulf Coast area, several personnel changes have been effected. **H. J. Thompson,** service engineer, was appointed store manager at Shreveport, La., and will be responsible for stores at Zwolle, Minden and Cotton Valley, La. **G. G. Moles,** service engineer, was appointed store manager at Homer, La., and will also manage Baroid Stores at Ruston, Arcadia and Bernice, La.

T. G. Gilbert has been named manager of the Canadian operation of **Electro-Technical Labs** with headquarters in Calgary, Alberta, Canada.

Claude L. Griffin has been appointed sales manager, United States and Canada, by **John C. Helies,** executive vice president and general sales manager, **Security Engineering.** Griffin has been active in the oil industry since 1933. Most recently he was vice president of **American Iron and Machine Works Company,** in charge of that firm's international sales.

Claude L. Griffin

H. R. Langford will head the new **Bucyrus-Erie Co.** district drill sales office in south San Francisco.

Ray Webb has assumed a new position as vice president and general manager of the **Inferno Manufacturing Corporation.** Webb, formerly advertising manager with the manufacturing firm for five years, will continue in that capacity and also assume additional engineering duties.

John W. Tynan, has been promoted to production manager for **Continental Oil Company's** Rocky Mountain region, with headquarters in Denver. Regional engineer for Conoco in Denver for the past three years, he succeeded **J. C. (Jimmy) Johnston,** who retired recently.

Howard M. Thompson has been appointed by the **Warren Automatic Tool Company** as manager of its Field Application department. In this position, Thompson will coordinate the development of new and improved instruments from the Research department to their practical application in the oil field. All field testing on the drilling rigs will be under his supevision.

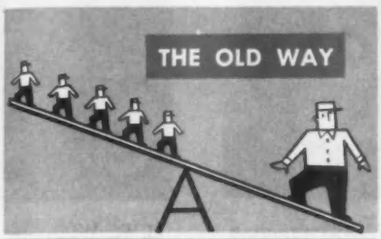
H. M. Thompson

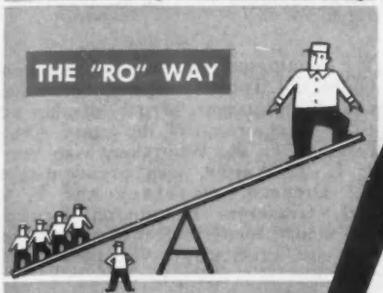
Bethlehem Supply Company announces several changes: **J. M. Finger,** store manager at Beaumont, Texas, has been transferred to the Beaumont shipyard of the Bethlehem Steel Shipbuilding division at Beaumont in a sales capacity. Replacing Finger as store manager is **H. R. Dooley,** formerly chief clerk at that point. **H. G. Nelson,** formerly store manager at Alice, Texas, has been promoted to special representative and transferred to the Texas Gulf district office in Beaumont. **L. R. Muhlinghause,** formerly special representative at Corpus Christi, Texas, has been transferred to Alice as store manager, replacing Nelson. **R. M. Cox,** formerly machinery sales representative at Shreveport for the Ark-La-Tex district has been promoted to special representative at that point and will specialize in tubular goods

LUFKIN *Initiative*

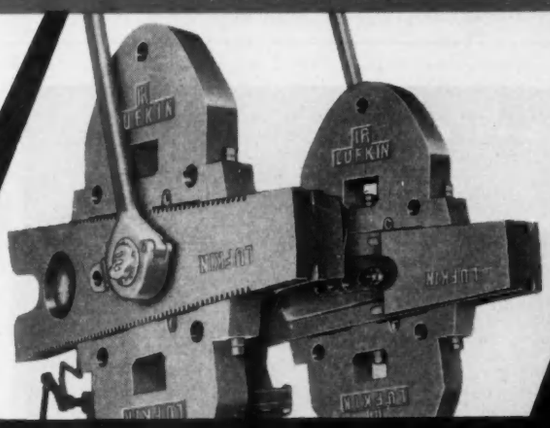
SCORES AGAIN! . . . WITH THE NEW

TROUT "RO" Series
COUNTERBALANCED CRANK*

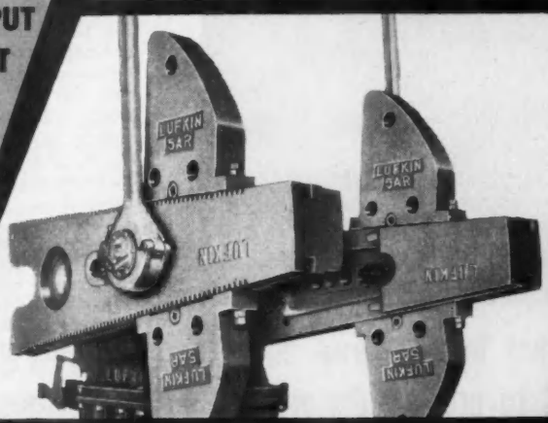




IT'S WHERE YOU PUT THE WEIGHT THAT GETS RESULTS.

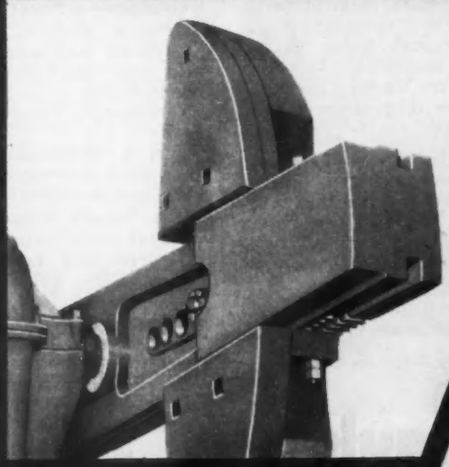


Larger counterweights for above average requirements. Increased thickness at end of crank for extra counterbalance.



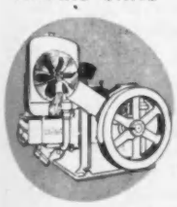
Smaller counterweights are interchangeable on the same cranks for reduced counterbalance requirements.

OFFERS *MORE EFFECTIVE COUNTERBALANCE FOR LESS WEIGHT

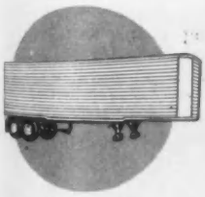


Extra space for thicker weights allows greater weight concentration at outer end of crank. Thick or thin auxiliary weights for greater counterbalance flexibility.

PUMPING UNITS



GAS ENGINES



TRAILERS

SPEED INCREASERS AND REDUCERS

You Can Relax When Your Lease Is **LUFKIN EQUIPPED**

LUFKIN FOUNDRY & MACHINE COMPANY

LUFKIN, TEXAS

Branch Sales and Service

HOUSTON • HATCHEZ • CORPUS CHRISTI • LAFAYETTE • DALLAS • KILGORE • ODESSA • HOBBS • GREAT BEND • DENVE
SHREVEPORT • WICHITA FALLS • LOS ANGELES • BAKERSFIELD • EFFINGHAM • CASPER • OKLAHOMA CITY • SIDNEY • MIDLAN
FARMINGTON • SEMINOLE • TULSA • NEW YORK • PAMPA • STERLING • MARACAIBO, VENEZUELA • ANACO, VENEZUEL

Lufkin equipment in Canada is handled by
THE LUFKIN MACHINE CO., LTD., 9950 65th Avenue, Edmonton, Alberta, Canada, Regina, Saskatchewan, Canada

sales. **R. A. Blair,** formerly special representative for the Kilgore, Texas, store, has been promoted to special representative for the Ark-La-Tex district and will continue to headquarter at Kilgore. **B. D. Robbins,** formerly machinery sales representative for the West Texas-New Mexico district at Midland, Texas, has been transferred to the Rocky Mountain district office in Casper Wyo., in the same capacity. **G. H. Underwood,** formerly store manager at Wichita Falls, Texas, has been promoted to local representative and assigned to the North Central district office at the same point. **L. H. Ligon,** formerly assistant store manager at Wichita Falls, has been promoted to store manager, replacing Underwood. **B. D. Johnson,** formerly floorman at Magnolia, Ark., has been promoted to field representative and transferred to Mineola. **G. H. Ford,** formerly field representative at Sweetwater, Texas, has been transferred to the Abilene, Texas, store in the same capacity. **R. J. Hebert,** formerly assistant store manager at Morgan City, La., has been moved to the Houma store in the same capacity. **J. E. Guy,** formerly floorman at Snyder, Texas, has been promoted to field representative at that point. **J. D. Lowry** was recently hired as a trainee and transferred to the Houma store. **D. W. Pipal,** trainee at Snyder was transferred to the Tulsa office. **M. W. Burnett,** formerly trainee, has been promoted to machinery sales representative and assigned to production equipment sales in the Tulsa office. **C. E. Green** has been employed as a machinery sales representative for the production equipment sales in Tulsa.

J. V. Pennington

C. R. Whittaker

J. V. Pennington was elected president of **Globe Oil Tools Company,** succeeding **Mrs. C. E. Whittaker.** Mrs. Whittaker will continue as chairman of the board. Other officers are **C. R. Whittaker,** vice president; **L. I. Wardle,** vice president-sales; **A. E. Drennen,** secretary and **F. C. Weigel, treasurer.** Pennington formerly was a management and engineering consultant and, previously a vice president of Reed Roller Bit Company.

W. P. Ogilvie who was supervisor of seismic operations for Accurate Exploration Limited in Edmonton has transferred to **Geoprosco Limited,** London. As seismic technical manager, Ogilvie will be responsible for all foreign operations of Geoprosco Limited and its subsidiaries. The former manager of Accurate Exploration, **W. N. Rabey** has also transferred to Geoprosco Limited, London, as executive assistant.

Jack C. Norton has joined the **Tyson Smith Company,** one of the **Smith Industries,** as sales manager for the Oil and Gas division. He will make his headquarters in Houston. Norton for the past year has been manager of export sales for the Oil Center Tool Company.

J. R. McReynolds has been transferred to the general headquarters of **The Youngstown Sheet and Tube Company** as assistant district traffic manager. McReynolds had been manager of the Traffic and Purchasing departments, Continental-Emsco Company, a division of Youngstown, since 1956.

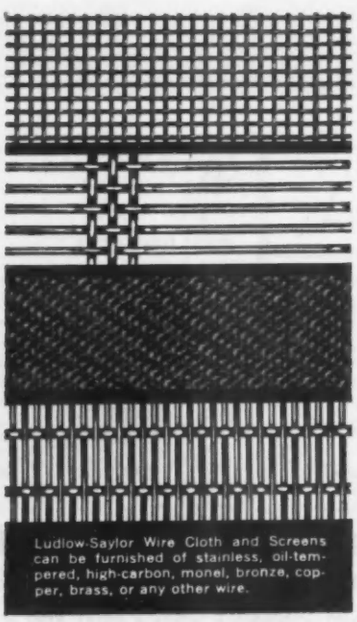
Carl J. Hochenauer, who for 44 years has been associated with the oil well supply industry and who founded the **Texoma Supply Company,** Tulsa, in 1937, has retired from all activities with this concern and now makes his home in Brownsville, Texas.

Penberthy Manufacturing Company of Detroit, a division of **Buffalo-Eclipse Corporation** announced the appointment of **Howard E. Strohmaier** as general manager. Concurrently **Arnold N. Lindeman** has been appointed general sales manager.

Braden Steel Company Bought By Flint Steel Corp. Associates

Braden Steel Co. of Tulsa has been sold to a group associated with Flint Steel Corporation, also of Tulsa. Braden will operate as a separate corporation and retain its own identity.

LUDLOW-SAYLOR shears — does not burn — wire ends to insure accurate dimensions and to prevent distortion



Ludlow-Saylor Wire Cloth and Screens can be furnished of stainless, oil-tempered, high-carbon, monel, bronze, copper, brass, or any other wire.

Burning off uneven wire ends, after screens are woven, is common industry practice... but not for Ludlow-Saylor! After being trued up on a leveling machine, they are sharply sheared to insure absolute accuracy and to prevent any distortion of the precision-woven openings.

This extra 2-man operation is typical of the many reasons why L-S Screens wear longer —stand up better under toughest conditions—and retain their rigid dimensional stability far longer than ordinary screens. *Order L-S Screens next time... you pay no more, but get much more!*

Immediate Shipment of most weaves and sizes

Write for Condensed Screen Reference Catalog

Ludlow-Saylor

WIRE CLOTH CO.

642 S. Newstead Ave. • St. Louis 10, Mo.

SALES OFFICES: Birmingham, 1727-6th Ave. N.; Chicago, 6261 West Grand Ave.; Pittsburgh, Union Trust Bldg.; Houston, 5638 Harvey Wilson Dr.; Denver, 1530 Carr St. WEST COAST SUBSIDIARY: Los Angeles, Star Wire Screen and Iron Works, Inc., 2515 San Fernando Road.

Jay C. Failing has been named chief sales representative for a new line of rotary earth-drilling equipment designed under his direction and scheduled for production by **Mobile Drilling, Inc.**

N. V. (Norb) Chehak

D. F. (Dave) Van de Roovaart

N. V. (Norb) Chehak has been named sales manager in charge of all domestic and Canadian sales for **Link-Belt Speeder Corporation. D. F. (Dave) Van de Roovaart** assumes the duties of assistant sales manager for U. S. and Canadian territories for the firm.

W. A. (Bill) Davidson, an industrial sales executive, has been appointed assistant sales manager at **Herb J. Hawthorne, Inc.**

Lewis C. Black has been appointed manager of domestic sales by **Bucyrus-Erie Co.** He had been manager of sales for large excavators since January, 1958.

Lee Hassinger, district manager for **The Dayton Rubber Company's** Industrial V-Belt division, was named top winner in the President's Sales Achievement Campaign, conducted by the company over a three-months' period. Hassinger received a plaque from **C. M. Christie,** Dayton Rubber president. He also received an all expense family vacation tour.

W. R. Barry, petroleum industry equipment design engineer, has joined **Philip L. McLaughlin and Associates,** Dallas. Barry will head a newly-established product design group, which will complement a Sales Research and Market Planning division, to be guided by McLaughlin. The firm also announced a change in its name—to **McLaughlin and Barry, Consultants.** The company will specialize in engineering and marketing consultation services for new products and the redesign and modernization of existing products marketed to the petroleum and related industries.

J. H. Coman was appointed vice president of **W. C. Norris, Manufacturer,** a division of **Dover Corporation.** In his new position, Coman as vice president in charge of materials will direct the operations of the Material Control, Warehouse and Shipping departments. He will also be responsible for the recently organized Machine Tabulating department.

J. H. Coman

K. L. Byerly, Jr. was promoted from general sales manager to vice president and general manager of **Magcobar de Venezuela,** C. A. Byerly succeeds **Ten Eyck Hull,** who has left the company, and will guide Magcobar de Venezuela's expanding operations from its Caracas headquarters.

Cardwell Manufacturing Company has named **Richard G. Jones** as sales representative for the South Texas area.

Charles F. Sarratt has become vice president and member of the board of directors of **Chris Well Servicing Co.,** with headquarters at Lindsay, Okla.

Peter H. Lauer has been elected treasurer of **Flexonics Corporation.** Lauer succeeds **R. R. Muller** who relinquished the responsibilities of treasurer to become general manager of the company's Aeronautical division.

Dr. Arnold O. Beckman, president of **Beckman Instruments, Inc.,** has announced the appointment of **Max D. Liston** as director of engineering, **Thomas V. Parke,** director of product standards, and **Earl C. Janson,** director of manufacturing, to serve on an enlarged corporate staff.

Allan Gardner has been appointed field engineer for the **Ralph N. Brodie Company.**

BRITISH H-E MADE

300 P.A. TRACTOR DRILLMASTER

MULTI-PURPOSE · HIGHLY MOBILE

The Hands-England Drillmaster 300 P.A. Rotary Drill is now available mounted on a Fordson Major Tractor and is illustrated on left.

This design provides great manoeuvrability and is intended primarily to enable the well known H-E Drillmaster 300 P.A. Rotary Drill to be used for Quarry and Open Cast blast or shot holes.

Although the H-E Drillmaster 300 P.A. mounted on a diesel engined tractor, is ideal for Quarry and Open Cast operations, it is equally applicable to some difficult "off the road" locations, such as may be encountered during seismic exploration particularly in highly cultivated areas.

An air compressor giving 99 C F M can be mounted directly onto the drill subframe and driven from the tractor engine. This compressor gives an up-hole annular velocity of 3,000 ft./min. when using flush jointed drill pipe and holes of the following sizes:

1⅝" o/d. Drill Pipe			2⅞" dia. hole		
1.29/32"	"	"	3⅛"	"	"
2⅜"	"	"	3⅜"	"	"
2⅞"	"	"	3¾"	"	"

Larger holes or holes drilled with mud circulation can of course be drilled, but the equipment for these operations must be mounted on a separate trailer or tractor.

The H-E Tractor Drillmaster will be found to cover the majority of drilling requirements of the Quarry and Open Cast operator, the Geologist, the Mineralogist, and the Geophysicist.

Write for illustrated folders giving full details and specifications of this equipment.

HANDS - ENGLAND OILFIELD EQUIPMENT LTD

MANUFACTURERS OF GEOPHYSICAL SUPPLIES

LETCHWORTH HERTS ENGLAND TEL: 600 CABLES: OIL LETCHWORTH ENGLAND

Exclusive licensees in Western Germany: August Goettker Flachbotrungen, 20a Wathlingen Kreis Celle, West. Germany

5802

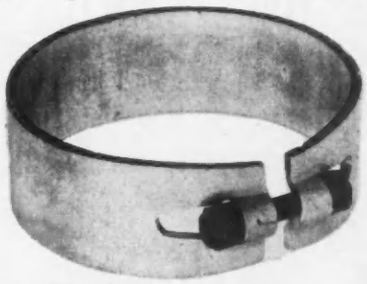
CF&I SEAMLESS casing and tubing AP

THE COLORADO FUEL AND IRON CORPORATION • DENVER, COLORADO

For more data on advertised products, use Readers' Service Cards, last page.

FRICTION-LOCK CLAMPS

give you these distinct advantages in mounting scratchers and centralizers:



LOWER COST . . . Friction-Lock Clamps cost less than welding when ordered with B and W Scratchers and Centralizers.

WITHSTANDS GREATER THRUST . . . exhaustive laboratory tests prove Friction-Lock Clamps withstand resistance to vertical movement far in excess of average field welding.

ELIMINATES WELDING DAMAGE . . . average field welding may damage casing from undercutting, hard spots and electrolytic corrosion . . . Friction-Lock Clamps cannot damage casing.

ONLY FULL GRIPPING DEVICE . . . only the Friction-Lock Clamp grips uniformly around the complete periphery of the casing . . . other holding devices grip over relatively small areas.

EASIER INSTALLATION . . . B and W Friction-Lock Clamps may be installed in seconds with a simple hex wrench.

ANOTHER FIRST BY THE FIRST NAME IN PRIMARY CEMENTING TOOLS

OTHER B and W PRODUCTS:

Multi-Flex Scratchers • Nu-Coil Scratchers • Rotating Scratchers, Multi-Flex and Nu-Coil Types • Automatic Stop Collars • Stabilizers • Rotator Collars • Liner Centralizers • Latch-On and Solid Type Centralizers • Thread-Lock Cages • Thread-Lock Cement.

B and W Inc.

Well Completion Specialists

GULF COAST
Box 5266
Houston 12, Texas
PHONE WAlnut 3-6603

WEST COAST
19706 South Normandie Ave.
Torrance, California
PHONE FAculty 1-2463

William C. Meeks, Jr., sales representative for **WECO** has been transferred from Hobbs, N. M., to Denver. Meeks will serve the oil industry in the Rocky Mountain area and northern New Mexico.

•

C. L. (Slim) Nelson has been appointed a Four Corners warehousing and service representative for **B and W Incorporated** primary cementing tools.

•

C. J. Zabcik has been named research and development engineer for **Baash-Ross Division** of **Joy Manufacturing Company.**

•

J. E. Shoemake was appointed manager, refinery and pipe line equipment sales of **U. S. Steel's Oil Well Supply Division.** He will be located in Houston.

Wheatley Mfg. Announces Firms New Representative

Frank Wheatley Pump and Valve Manufacturers have appointed James H. Withers and Company as the firm's manufacturers' representative on the West Coast.

James H. Withers

Withers will handle the entire line which centers around plunger and rotary pumps and plug and check valves. The new representative offices are in Long Beach, Calif.

Clark Bros. Co. Signs Agreement With Armstrong Siddeley Motors

A new manufacturing agreement between Armstrong Siddeley Motors Ltd. and Clark Bros. Co. Division of Dresser A.G. has been signed. Terms of agreement provide for licensed manufacture in the United Kingdom of gas turbines designed and made by Clark in the U. S.

Initial activity of the new team will include the production of an undisclosed number of giant turbine units for major oil and gas producers throughout the world. It will be followed by other long-range production of gas turbines for the oil, gas, chemical and process industries in the major world markets.

Continuing Revitalization Plan Going on at Worthington Corp.

The Worthington Corporation has been undergoing a complete company streamlining—from top to bottom.

The latest reflection of these moves stemming from the revitalization program that began almost 10 years ago, is the adoption of a new trademark on Sept. 24, 1958. The 73-year-old winged trademark will be replaced with a modern mark.

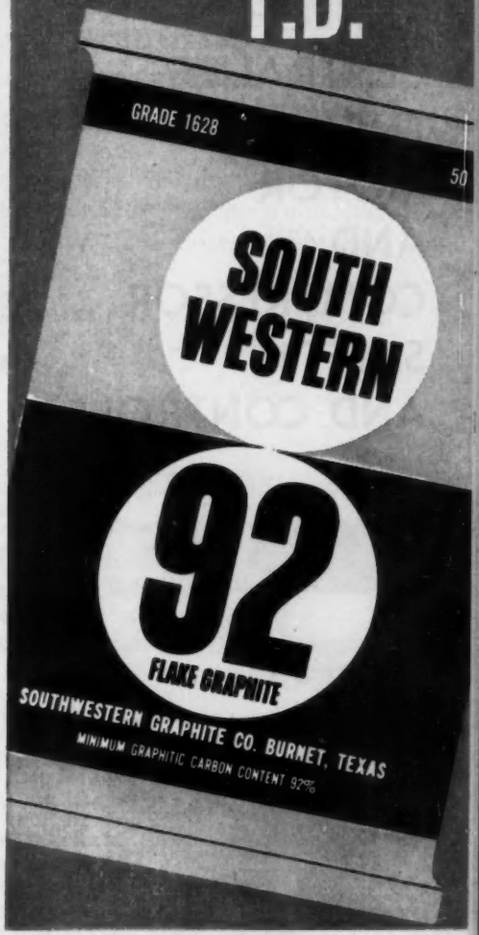
South American Office Opened by Graver Tank

The International division of Graver Tank & Mfg. Co., Inc., has established an office in Caracas, Venezuela, with William I. Woodson as general manager.

Graver's International division was established last January and maintains operations around the globe outside the United States.

Woodson formerly served as manager of the Venezuelan division of Texas Pe-

SLICKEST WAY TO T.D.



USED AND RECOMMENDED

. . . *especially* under conditions where TORQUE, DRAG, OR THE HAZARD OF STICKING DRILL-STEM AND CASING are encountered.

FIVE YEARS OF FIELD EXPERIENCE

have proved the effectiveness and versatility of

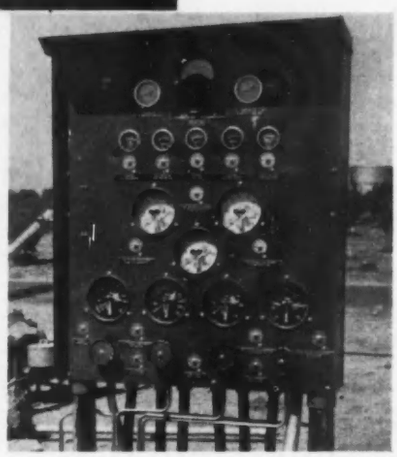
SOUTHWESTERN 92 FLAKE GRAPHITE

Available through your mud dealer.

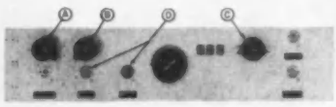
SOUTHWESTERN GRAPHITE CO.
BURNET, TEXAS

MURPHY

MODULAR PANELS CENTRALIZE ENGINE, OR MOTOR AND COMPRESSOR SAFETY AND CONTROL!

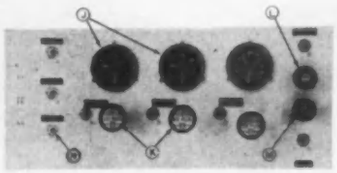


A Fillmore, California Installation



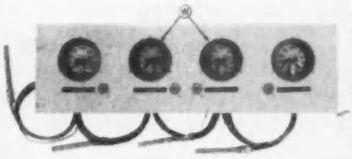
ENGINE CONTROL PANEL

Murphy Engine Safety Switches provide visible indication as well as positive shutdown in the event of trouble. A typical panel is equipped with (A) water temperature (SR-21), (B) oil pressure (0-75), (C) overspeed and overload (V-230), safety switches. In addition, individual Murphy "Tattletale" Switches (D) are installed to give indication of the cause of shutdown.



COMPRESSOR CONTROL PANEL

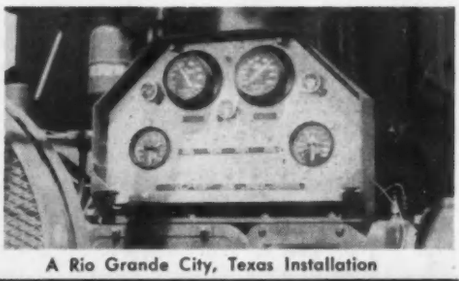
Complete compressor protection is afforded each function of your valuable equipment by this modular panel consisting of the following standard Murphy safety switches:
(J) OPL-F Hi-Lo Pressure Switches complete with (K) pulsation dampeners for suction, interstage and discharge pressures; (L) one compressor water jacket temperature (SR-21), (M) one compressor oil pressure (0-75), (N) one compressor oil level (L-100-W), and individual "Tattletale" Switches to show cause of shutdown. Saves valuable time in trouble-shooting.



COMPRESSOR TEMPERATURE CONTROL PANEL

These Murphy SPL Hi-Lo Temperature Safety Switches (W) will provide your compressor with precise temperature indication and protection throughout the system. Compressor operating conditions are most readily indicated by line temperatures and Murphy SPL units protect against excessive temperatures. Stainless steel seperable sockets permit easy installation.
Murphy "Tattletale" Switches pinpoint trouble automatically. SPL switches are available in these standard ranges: 100°-350°F, 260°-450°F, 30°-300°F. Other ranges on request.

Only Murphy Safety Switch offers complete compressor instrumentation providing indicating gauges with positive shutdown protection in standard or semi-standard panels with prices that S-T-R-E-T-C-H your equipment dollar.
Engine or electric-motor powered, your compressor can be Murphy-equipped through local dealer stocks of standard components or contact our Engineering Department for complete details.



A Rio Grande City, Texas Installation

IN THE FAR WEST
11812 DAVENPORT ROAD
LOS ALAMITOS, CALIF.

FRANK W. MURPHY *Manufacturer, Inc.*
RANCH ACRES STATION TULSA, OKLAHOMA

troleum Company and also in Turkey as petroleum advisor to the Turkish government.

Hercules Motors to Market German-Built Products in U. S.

Hercules Motors Corporation has acquired American distribution rights to the German-built "Jlo" line of air-cooled diesel and gasoline industrial engines within the continental limits of the Unted States.

In an agreement signed with Rockwell, G.m.b.H.—West German owned subsidiary of Rockwell Manufacturing Company—Hercules will market Jlo engines in the U. S. as the Jlo series.

The new engines were shown first in the United States at the Society of Automotive Engineers' National Farm Construction & Industrial Machinery meeting in Milwaukee, Wis., recently.

Cranes Lower Vessel

Two huge cranes work together to lower a 72,000 pound pressure vessel into position in the new high-pressure laboratory of Schlumberger Well Surveying Corporation. The vessel has a working pressure of 30,000 psi at 450° F., equivalent to hydrostatic pressures to be encountered in wells drilled well below 30,000 feet with normal drilling muds.

Union Tank Division Moves Into Farmington, N. M., Office

The Union Tank division of Butler Manufacturing Company has completed and occupied a branch office and warehouse in Farmington, N. M.

Frederick C. McDaniel will serve as manager of the new branch office.

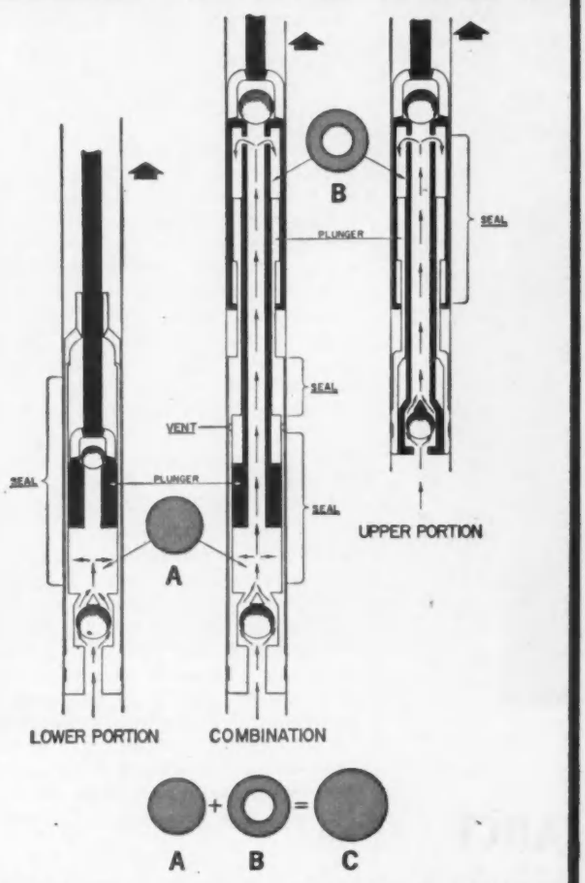
Cherokee Laboratories Acquires McNamar Boiler & Tank Co.

Cherokee Laboratories, Inc., of Tulsa has acquired McNamar Boiler & Tank Co., which will merge with two other steel products companies.

The new firm will be temporarily named Southwest Steel Co., and all manufacturing will be at the McNamar plant location. Eventually the company will be named Cherokee Steel, Inc.

The other steel firms which have merged

NEW AXELSON VOLUMAX INCREASES PRODUCTION FLOW



Shaded circles indicate volume areas. Plunger area (A) plus annular area (B) result in increased production area (C).

Axelson's new Volumax pumps will outperform any similar pump currently available for 2" tubing.

Special ⅞" liner column uses ⅞" plunger to effectively seal and create an upper telescoping annulus. Resulting production is 22% more than that obtained with a tubing pump.

Lower portion plunger area (A), plus upper portion annulus area (B), combine to provide increased volume (C).

ALL VOLUMAX PUMPS PROVIDE THESE ADVANTAGES:

1. Volumax pumps may be operated at a depth limited only by sucker rod stress.
2. Tandem pump construction provides extreme rigidity of all parts during compression portion of stroke (downstroke).
3. Maximum fluid passage — minimum drag.
4. Optimum plunger fits established through practical field experience.
5. Exceptionally good hold-down ability.
6. An insert pump, tubing need not be pulled.

Write today for the new Volumax brochure

AXELSON

There is no economical substitute for quality.

AXELSON MANUFACTURING COMPANY

Division of U. S. Industries, Inc.
6160 So. Boyle Avenue, Los Angeles 58, Calif.

Since 1898 products designed to give oil a lift

AXELSON PRODUCTS ARE DISTRIBUTED EVERYWHERE

CALIFORNIA: Axelson Sales and Service Stores in all principal California fields
Hickey Pipe and Supply Co., (sucker rods), Los Angeles, Coalinga

MID-CONTINENT AND EASTERN: Jones and Laughlin Steel Corp., Supply Division, Tulsa

ROCKY MOUNTAIN: Jones and Laughlin Steel Corp., Supply Division, Tulsa
Great Northern Tool and Supply Co., Billings

CANADA: Jones and Laughlin Steel Sales Co., Ltd., Supply Division, Calgary
Dominion Oil Fields Supply Co., Ltd., Calgary

FOREIGN: Represented in all major oil-producing areas.

© 1958 – Axelson Manufacturing Company, Div. of U. S. Industries, Inc.

are Southwest Steel Co. and Santa Fe Steel Co., both of Tulsa.

David A. Garrick, president of Cherokee, will be president of the new combine and James Jackson, president of McNamar, vice president. The company will be a subsidiary of Cherokee Laboratories, which owns several other companies.

Ball & Black Supply of California Is New Gray Tool Representative

Gray Tool Company, Houston manufacturer of wellhead control systems, Grayloc pipe connections and rotary swivels, announces the appointment of Ball & Black Supply Company as California representative for Gray's oil field equipment.

El Paso Branch Office Opened By G. M. Wallace and Company

G. M. Wallace and Company of Denver, representing Cochrane Corporation for water-treating and steam specialty equipment, announced the opening of a branch office at El Paso, Texas.

It is under the direction of B. M. Huffman, a professional engineer.

Large Parkersburg Pumping Unit Slated for Shipment to S. A.

Manufacture and assembly of one of the world's largest pumping units has been completed at the Coffeyville, Kan., plant of The Parkersburg Rig and Reel Company and is now being tested. Upon completion of tests, the unit will be shipped to South America.

With a lifting capacity of 62,000 pounds and a maximum stroke length of 120 inches, the unit base is 31 feet 4½ inches long and 9 feet wide. The height of the unit in midstroke is approximately 26 feet.

International Management Group Affiliated With 19 Organizations

Widely expanded growth of 19 affiliated companies operating throughout the world recently resulted in formation of a new international management organization known as Kendavis Industries, Inc., International.

Officers and an advisory committee were announced at Fort Worth headquarters by Ken W. Davis, president of the new corporation.

Companies affiliated with the new organization include: Compania Pionera de Venezuela, C.A.; CP-Harrisburg, Inc.; Cummins Sales & Service, Inc.; Cummins Sales & Service de Venezuela, C.A.; Dorris Ballew, Inc.; Great Western Drilling Company; six domestic and foreign organizations of the Loffland Brothers group, including Loffland Brothers Company; Loffland Brothers Company of Canada; Loffland Brothers Company of Venezuela; Loffland Brothers de Venezuela, C.A.; Loffland Brothers de Caracas, C.A.; and Loffland Brothers Company of Peru; Mid-Continent Cummins Export Corporation; Mid-Continent Supply Co.; Mid-Continent Supply Co. of Venezuela, C.A.; Pioneer Well Services, Ltd.; Stratoflex, Inc.; Stratoflex of Canada, Inc.; and Unit Rig & Equipment Company.

Officers announced by President Davis included vice president and comptroller, Ken Davis, Jr., chairman of the board of Loffland Brothers Company and of Unit Rig & Equipment Company; general vice president, Thomas N. Shults, president of Midcumport and a Mid-Continent vice president; vice president-communications, Victor LeMay, Mid-Continent public relations and advertising director; vice president—manufacturing, John W. Tullis, Stratoflex vice president and general manager.

Infilco Names VanderMolen Assistant Sales Engineer

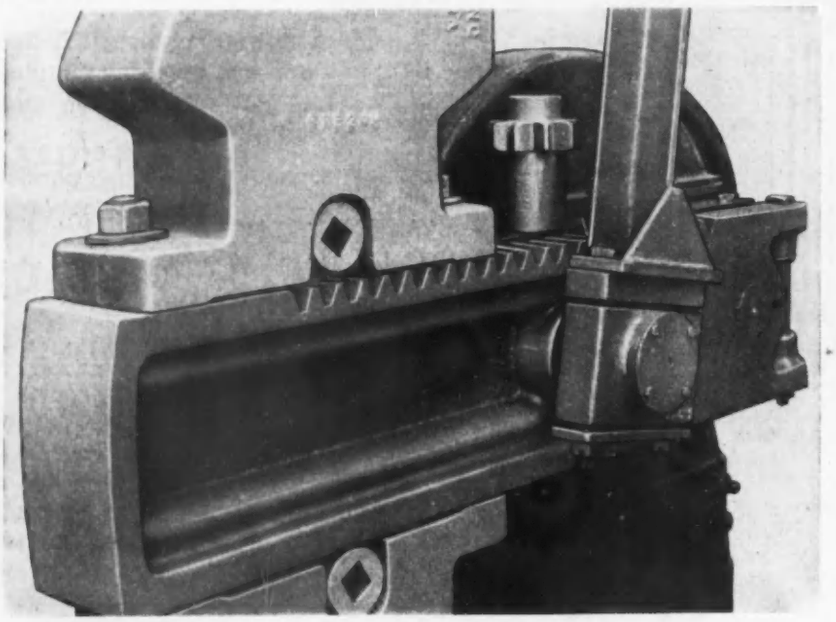
Infilco Inc. with headquarters in Tucson, Ariz., has announced several appointments. C. T. VanderMolen has been appointed assistant sales manager with supervision of Sales Engineering department.

H. W. Frazer has been promoted to the new position of industrial project manager. L. H. Piper will head a new Project Engineering department.

F. H. Maloney Co. Enlarges Plant Area in Houston

F. H. Maloney Company has announced an expansion program in Houston, including construction of two new buildings and the purchase of additional plant production equipment.

One of the structures, to comprise 10,000 square feet, will be devoted to rubber finishing, warehousing and shipping. The second building will house a production assembly line for pipe line equipment.



NEW
JENSEN ROTARY COUNTERBALANCE

Jensen's rack-and-pinion system makes weight adjustments a safe and simple operation for just one man—standing on the ground. Gives both lead and lag counterbalance, requires no special equipment.

And that's just one of the many forward-locking features you'll find on the all-new JENSEN ROTARY BALANCED JACK. For the full story, call, wire or write us—today!

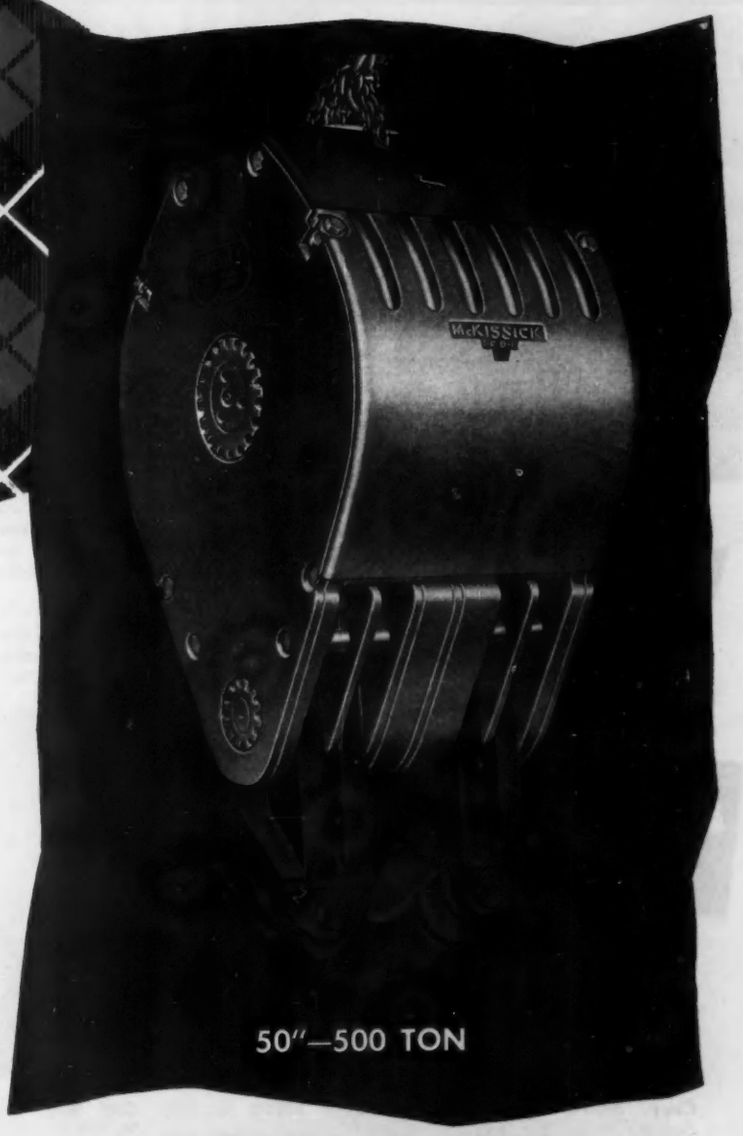
STOCKED BY YOUR LOCAL SUPPLY STORE

Made by JENSEN BROS. MFG. CO., INC.,
P. O. Box 477-D, Coffeyville, Kansas
Export Office: 250 Park Avenue, New York 17, N. Y.

JENSEN JACKS

big

better



BETTER BECAUSE:

- 16,000 pound weight insures free non-wobbling falls, under multiple sheave string-up with large diameter drilling lines.
- Heavy divider plates between each sheave, more evenly distribute heaviest loadings and eliminates center pin deflection.
- Johns-Mansville "Klipper" grease seals positively retain lubricant, exclude all foreign matter from bearing cavity.
- 50" O. D. Alloy steel flame hardened sheaves grooved to proper line SIZE—Double row pre-adjusted Timken bearings, mounted on 10½" diameter alloy steel shaft.
- E-Z opening guards for quick stringing up. No bolts to pull out and lose.

Write for complete McKissick catalog.

McKISSICK PRODUCTS CORPORATION
Box 2496 Tulsa, Oklahoma

McKISSICK

Lufkin Foundry And Machine Co. Now Using New Shop Facilities

A new welding and structural shop for the Lufkin Foundry and Machine Co. is now in use.

The building is being used to assemble oil field pumping units manufactured by the company. It was begun about a year ago and cost more than $200,000 as part of a continuing program of plant improvement and expansion.

Fire Effects Extensive Damages To Hycalog Shreveport Facilities

The diamond bit manufacturing plant and well logging maintenance shop of Hycalog Inc., Shreveport, La., was destroyed by explosion and fire recently. J. R. (Frenchie) Mayeaux, Hycalog president, estimated the loss between $250,000 and $300,000 in buildings and inventories of materials, equipment and parts.

Mayeaux said, however, that Hycalog will continue its operations providing well logging and diamond drilling tool services in 23 states. He stated that only one of the company's 43 logging units was in the repair shop at the time of the fire. He estimated that the company has diamond tool inventories throughout its area of operations sufficient to continue filling orders without delay.

One of the greatest losses to the company was its research laboratory, but over $100,000 worth of industrial diamonds stored in a fire proof vault were undamaged.

Plans have been started for rebuilding the plant, Mayeaux stated, and until that time, machine work for the diamond tool manufacturing division will be contracted to other Shreveport machine shops.

Youngstown Sheet and Tube Co. Expands General Sales and Order

The Youngstown Sheet and Tube Company announced the enlargement of its General Sales and Order departments in the recently occupied new general office building in Youngstown, Ohio. Along with the added force, a modernized and enlarged wire communication center has been established in the home office.

More teletype equipment has been installed in the Youngstown and Indiana Harbor Mill production planning centers at East Chicago, Indiana.

Sales and Order department changes involve the transfer of the following personnel from Chicago to Youngstown: J. P. DeHetre, assistant general manager, sales; P. H. Booth, manager, alloy sales; R. V. Nilsson, manager, tin plate sales; R. W. Mowry, assistant manager, flat rolled sales; W. H. Stokes, tin plate sales; and W. H. Schaper, chief clerk, Order department.

The following general sales staff organization will be located in Chicago: P. G. Boyd, western manager of sales; D. C. Umbel, assistant manager, flat rolled sales; C. T. Selander, assistant manager, pipe and conduit sales; E. G. Brick, alloy and carbon bar sales; and F. C. Sterling, "Yoloy" sales.

Pulsometer Engineering Is Making Ideco Mud Pumps in England

Pulsometer Engineering Company Limited, an English pumping and allied equipment manufacturer, is now building Ideco mud pumps under a license agreement concluded with Dresser Limited, C.A., a subsidiary of Dresser Industries, Inc.

Geo. W. Walton, president of Ideco, Inc., of Dallas, said that this new license agreement for pumps would complement the manufacturing facilities of another English licensee, Woodfield Rochester Limited, which has been building complete Ideco rigs since 1952, and would make pumps and replacement parts readily available to customers in the sterling areas.

Creole Eng. Gets New Name, Renamed C-B Southern, Inc.

Following closely Cooper-Bessemer's recent acquisition of Creole Engineering as a wholly owned manufacturing and engineering subsidiary in Houston, is the change in name to C-B Southern, Inc.

C-B Southern's initial engineering and manufacturing will concentrate on completely packaged, pre-piped gas engine compressor units of the type widely marketed by Cooper-Bessemer for gas gathering and similar requirements, but formerly packaged by other companies.

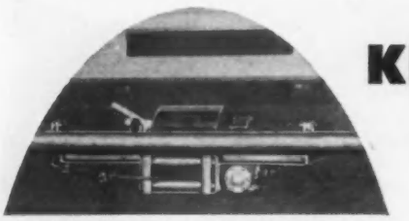
Modern Offices Now Occupied By Petroleum Technologist, Inc.

Petroleum Technologists, Inc., observed Oil Progress Week this year in a manner indicative of the progress of the oil industry in Texas—by moving into its new 10,600-square-foot modern laboratory and executive building in Dallas' Brook Hollow Industrial district.

The move was made October 15, dur-

KING WINCHES

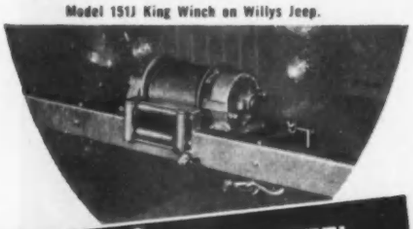
. . . for Willys, International, Chevrolet, GMC, Ford, Land Rover and other vehicles



Model A-11 King Winch on A-120 (4x4) all-wheel-drive International truck.*

Model CD-8116 King Winch on 1958 Chevrolet Model 31 (4x4).

Model 151J King Winch on Willys Jeep.



COMPLETE, READY-TO-INSTALL KING FRONT-MOUNT WINCH ASSEMBLIES FEATURE:

- winch side arms to reinforce truck frame
- bronze-bushed, 4-way cable guide rollers
- cable drum guard
- heavy-duty pipe bumper
- needle-bearing, universal-joint spline-shaft drive assembly
- Timken bearings on worm

King Winches keep you moving through the most difficult terrain . . . you get action where there's no traction with dependable pulling power. King power winches have pulling capacities of 8,000 to 19,000 lbs.

** King Winches for International trucks are available through International-Harvester dealers.*

Koenig ALL-STEEL CABS FOR JEEPS

FULL AND HALF CABS

Full Cab and Model 151J King Winch Illustrated.

Koenig Jeep cabs and King Winches for Willys vehicles are available through Willys Motors, Inc., and Willys-Overland Export Corp. distributors or dealers. Write for free descriptive literature.

KOENIG ALL-STEEL CABS HAVE THESE SUPERIOR FEATURES:

- PROTECTION
- SAFETY
- COMFORT
- CONVENIENCE

Roll-down windows, full opening . . . full panel-board head lining and masonite door lining . . . safety glass throughout . . . all-steel welded construction . . . door locks.

IRON WORKS, Inc.

P. O. BOX 7726 • HOUSTON 7, TEXAS

On the loading docks of your **supply store** gather the customer, supply house man, Baash-Ross sales engineer and the superior equipment that have aided the oil man in developing today's efficient drilling and production methods. An integral part of the American oil field system, your **supply store** strives to have conveniently at hand every item needed by any oil field worker for his job.

Working with your **supply store** are well trained, capable representatives of recognized manufacturers of quality oil tools such as Baash-Ross. These representatives add specialized local service on their particular equipment to the convenience of local stocking by the **supply store.** Together they provide you with the best equipment and service available to any industry in the world today.

So when you need slips, rotary bushings, safety clamps, spiders or other drilling and production equipment, call your nearby Baash-Ross representative and meet him at your convenient **supply store** for complete stocks and superior service.

NEW 1959 CATALOG NOW AVAILABLE! **Get your copy by writing to P. O. Box 1348, Houston 1, Texas.**

BAASH-ROSS DIVISION
OF JOY MANUFACTURING COMPANY

GENERAL OFFICES: 5306 CLINTON DRIVE, HOUSTON, TEXAS

AREA OFFICES:
HOUSTON, TEXAS, ODESSA, TEXAS, DALLAS, TEXAS; LONG BEACH, CAL.; CASPER, WYOMING; OKLAHOMA CITY, OKLA.; OLNEY, ILL.; CALGARY, ALBERTA CANADA; NEW YORK, N.Y. (EXPORT OFFICE)

FOREIGN OFFICES:
MONTE CARLO, MONACO; MEXICO CITY, MEXICO; GREENOCK, SCOTLAND; LONDON, ENGLAND; PARIS, FRANCE; CARACAS, VENEZUELA; BUENOS AIRES, ARGENTINA; RIO DE JANEIRO, BRAZIL; TEL AVIV, ISRAEL; TOKYO, JAPAN

BAASH-ROSS JOY

ing Oil Progress Week.

Petroleum Technologists will serve the Mid-Continent area from its new building which will also house the Mid-Continent Laboratories of the company.

Manager of the Mid-Continent Laboratories, which is also headquartered in the Brook Hollow building, is Harold S. Deyo.

Cummins Engine Company, Inc., Plans $6 Million Expansion

Cummins Engine Company, Inc., announced plans for construction of a major addition to its manufacturing plant with construction to start late in 1958.

The new facilities, to cost in excess of $6 million including equipment, will provide about 300,000 square feet of additional floor space, an increase of 38 percent, and will be the largest single building on the present site. It will include new engine test cells, additional space for the assembly of marine engines, diesel-electric generating sets, power units, and adequate export boxing areas and shipping docks. The new facilities will also include an additional power house.

Lane-Wells Co. Designates Houston as World Headquarters

Houston is the new world headquarters for Lane-Wells Company, a division of Dresser Industries, Inc. Key personnel of the organization were brought from Los Angeles; the remainder of the staff of more than 150 employes for the headquarters will be composed of Houston residents.

The organization will continue to be known as Lane-Wells Company.

Neale will continue as president of the company; Kirby Gee, formerly president of Elgen Corporation, will be vice president in charge of operations. Other officers include Jas. D. Hughes, vice president in charge of sales; John H. Zauner, vice president and technical director, and R. W. Keener, vice president.

Frazee, Campbell to Manage Kane Boiler Works in Houston

Kane Boiler Works, Inc., Galveston, Texas, has opened a new sales office in the Bank of The Southwest Building, Houston.

L. D. (Len) Frazee, who was recently named vice president, will share responsibility of the Houston office with G. W. (Jerry) Campbell, sales manager.

U. S. Rubber and Rumianca Co. Form Chemical Products Firm

United States Rubber Co. and the Rumianca Co. of Turin, Italian chemical firm, announced that they would jointly form a new company in Italy to manufacture and sell a line of chemical products developed and manufactured by the rubber company's Naugatuck Chemical division.

The new company, to be called Naugatuck-Rumianca, S.p.a., will have its headquarters in Turin and its manufacturing plant in Borgaro Torinese, a suburb of Turin. Among the products it will make and sell are accelerators and antioxidants for the rubber industry, a group of agricultural chemicals and a series of chemical specialties.

The products, patented by Naugatuck Chemical, will be made and sold on an exclusive basis in Italy, and sold on a non-exclusive basis in several other countries.

Grant Oil Tool Company Opens New Branch in Liberal, Kan.

Grant Oil Tool Company has opened a new branch in Liberal, Kan., with a complete line of stabilizing, reaming and hole enlarging tools.

This new branch will provide more efficient service and sales of Grant products in the southern Kansas and Texas panhandle areas.

Kenneth Shellman, field engineer with Grant for 17 years, has been appointed branch manager.

Burhans-Sharpe Co. Named To Represent Kerotest Mfg.

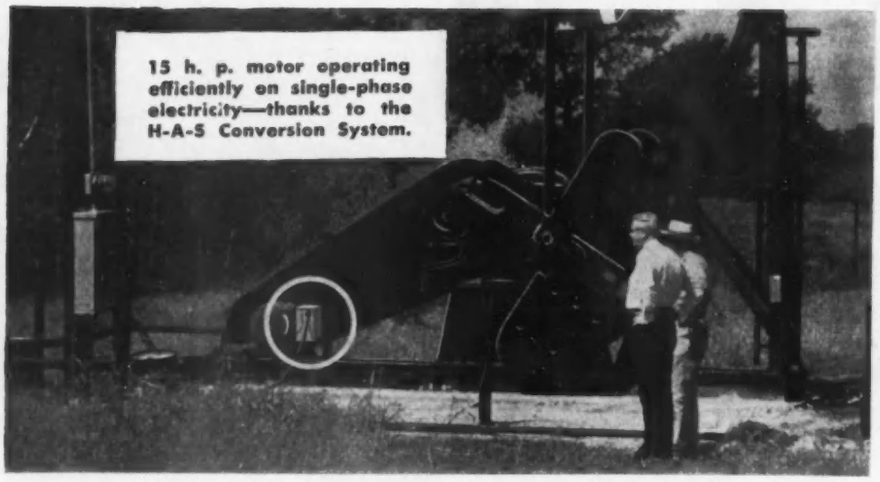
The Burhans-Sharpe Company with offices in Seattle, Wash., and Portland, Ore., has recently been appointed manufacturer's representatives of Kerotest Manufacturing Company of Pittsburg, Penn.

The territory covered by the Burhans-Sharpe Company includes the states of Washington, Oregon, and Idaho.

Norvell-Wilder Supply Co. Opens Ninth Branch Warehouse

The ninth branch warehouse of the Norvell-Wilder Supply Company of Beaumont was opened recently.

The new branch is located at Monahans, Texas, some 40 miles southwest of Odessa, and will greatly supplement the company's services in West Texas, espe-



Write for this NOW!

"How to use three-phase motors on SINGLE-PHASE CURRENT"

. . . and profit from the added economy and efficiency!

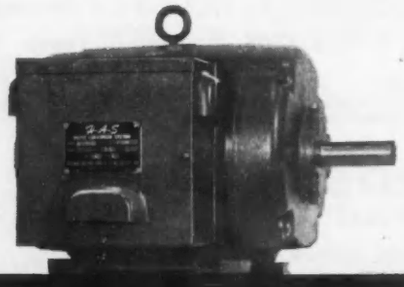
Three-phase motors cost less than single-phase motors, are more efficient, and have far greater salvage value.

The NEW H-A-S Phase Conversion System enables you to use three-phase motors (3 h. p. or larger) on 220 V single-phase current. Three-phase motors cost less, operate for less, and can be used later on three-phase current.

On many rural single-phase lines service is limited to 5 h. p. single-phase motors, but the H-A-S Phase Conversion System permits the use of three-phase motors up to 75 h. p.

The H-A-S is available in two models, for motor mounting and remote mounting.

This is GOOD NEWS in the oil country. To solve an immediate problem —or for your files—write NOW for the interesting details!



KEN ELLIOTT MOTORS, INC.
P. O. Box 5158
BOSSIER CITY, LOUISIANA

H-A-S PHASE CONVERSION SYSTEM

Another **WELEX** **PRODUCTION GUIDE**

INDUCTION ELECTRIC LOG

BETTER THREE WAYS

1. **Better thin bed response.**
2. **Deeper Investigation.**
3. **More detail.**

You get all three field tested advantages with the new Welex 5-coil Induction-Electric Log.

W E L E X, I N C.

ORIGINATORS OF Welex JET PERFORATING

General Offices:
1400 East Berry, Fort Worth, Texas
Division offices in
Denver, Houston, La Habra, Midland,
New Orleans, Tulsa and Wichita.
District offices in every major oil center.
Subsidiaries in
Canada, Peru and Venezuela.

cially in the Permian Basin development.

New sales offices have been recently opened in New Orleans and Baton Rouge, La.

Beck-Hill, Inc., Newly Organized To Headquarter in Houston

Beck-Hill, Inc., has been organized by J. Ed Hill, president, Julius S. Beck, vice president, and F. J. (Bud) Bradford, vice president.

The company will be engaged in drilling suspension tools. Headquarters have been established in Houston, and district offices have been opened at Long Beach, and Ventura, Calif. and Lafayette, La.

Tube-Kote, Inc., Dedicates New Research Laboratory

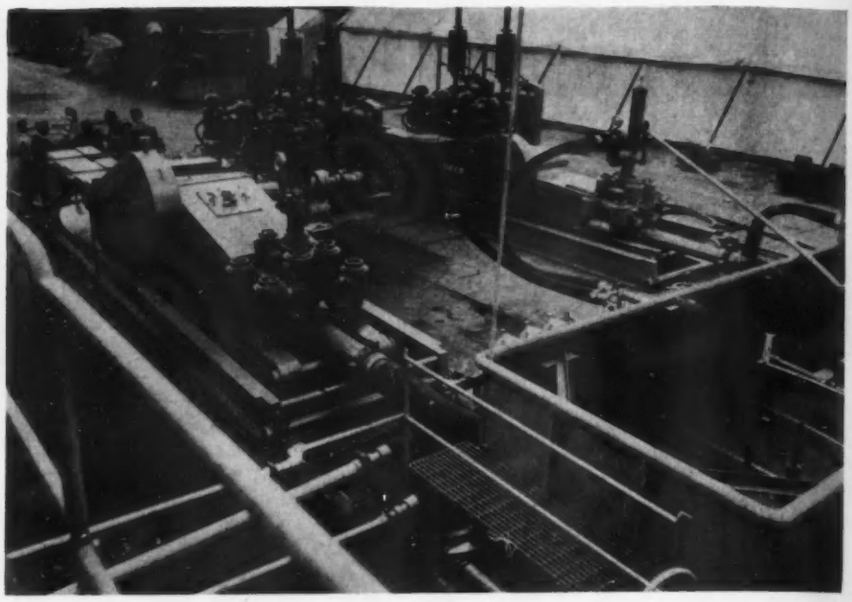
Tube-Kote, Inc. dedicated a new research laboratory recently.

The new laboratory facilities house Tube-Kote's quality control, production control, the research sections and the coating evaluation activities of the firm.

"Systems-Engineering" Study Undertaken by Two Firms

A co-operative development study between The Standard Oil Company (Ohio) and Thompson-Ramo-Woolridge Products Company was announced at the Instrument Society of America's Annual Instrument-Automation Conference recently.

The purpose of this study is to explore new frontiers in the control of Sohio's refinery units. This joint study will be based on newly developed "systems-engineering" approach to process optimization.



Portable Mud Pump for Rigs

The pumps on view are two which are being supplied complete with all drilling equipment, camp and living accommodation and transportation by Woodfield Rochester Ltd., working in close co-operation with Ideco, Inc., was on display recently in England. It is unnecessary to dismantle drive chains to move from one location to another. This applies to the rig as a whole, and contamination of machinery elements and re-alignment problems are avoided. Full use of built-in items has been made with the minimum of loose pieces. With the mud pumps, known as the Ideco 450 and Ideco 600, designed to meet the needs of a fast-moving outfit, the rig may be moved without disturbing the mud equipment supply. The live mud tanks have built-in suction lines equipped with end closure type suction valves and pneumatic seals, bottom type mud guns arrange to effect valve clearance, water lines and mud ditches. A stand pipe extension, kill line and fill-up line is built into the rig ramp and effects a fast hookup to the high-pressure manifold which is skid-mounted.

KEEP PURE DRINKING WATER ALWAYS HANDY

insist on the highest quality

Gotkool
water cans and coolers

Specify **"GOTKOOL"** the next time you order water cans or coolers. **"GOTKOOL'S"** exclusive construction keeps water cooler . . . fresher . . . purer. Extra wide, snug-fitting, splash-proof top keeps out impurities. Non-leaking, push-button faucets, either extended or recessed flush-mounted. *Buy* **"GOTKOOL"** *at your supply store today.*

GOTKOOL Water Cooler — made in 1½-, 2-, 3-, 5-, 10-, 15-, and 20-gallon sizes with either extended or recessed, flush-mounted faucet.

GOTKOOL Water Can — made in 1½-, 2-, 3-, 5-, 10-, 15-, and 20-gallon sizes without faucet.

Insist on the genuine — look for the *Blue and Black Label* with the name "GOTKOOL" in Red.

H. P. GOTT MFG. CO.
WINFIELD, KANSAS

From the ROYAL FAMILY of
KING SWIVELS
NEW
30, 40 & 50 KG SWIVELS
All with 3" watercourse

NEW

packing box arrangement eliminates necessity of removing gooseneck and bearing housing to change packing, thus eliminating thread-galling.

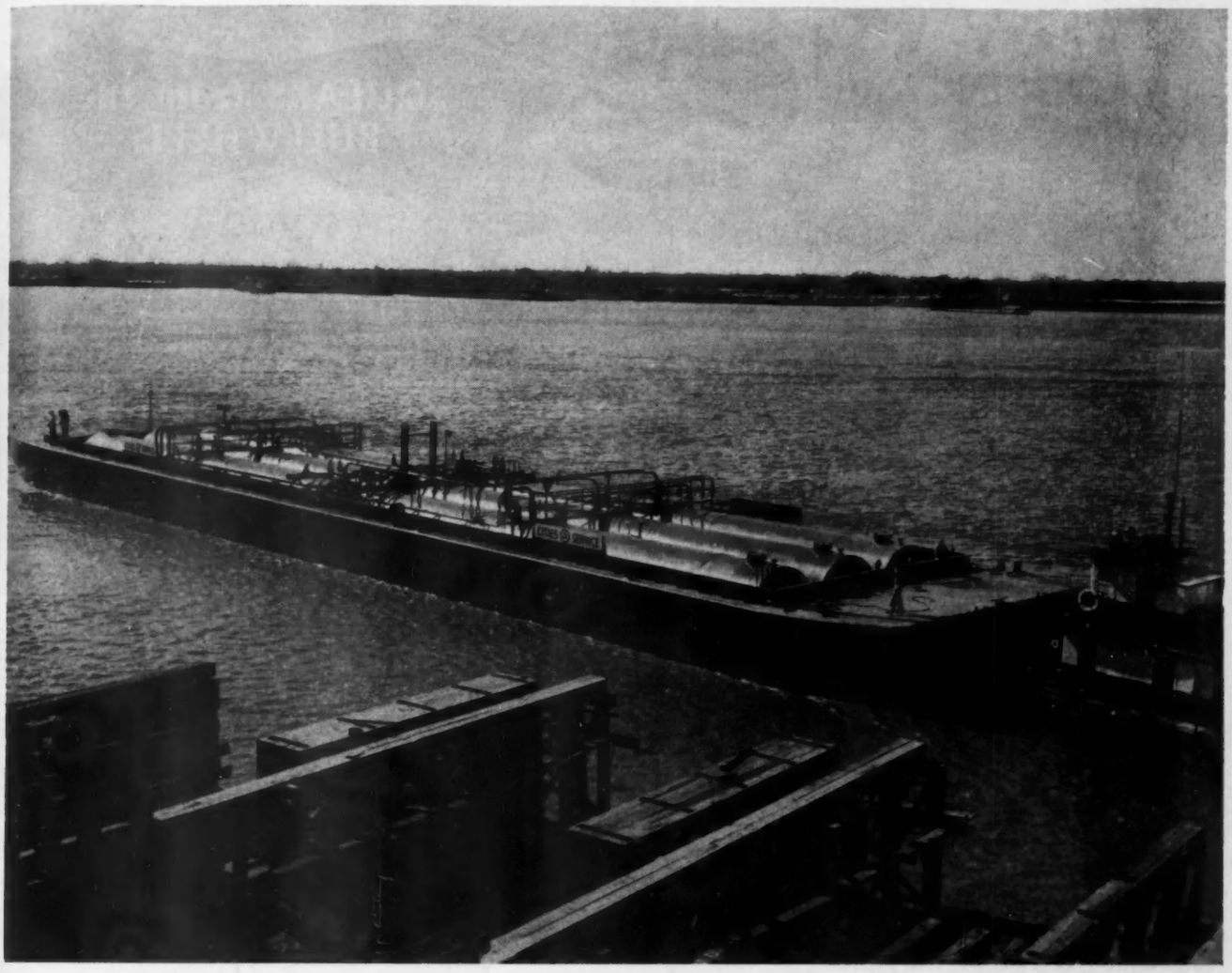
SUPERIOR PERFORMANCE

at 100 rpm to 6,200 feet with 2⅞", 3,800 feet with 4½" drill pipe. . . . Perfect for drilling relatively shallow oil wells, the deepest of water wells, workover rigs and slim hole drilling!

NEW! • Wash-pipe packing box arrangement — interchangeable, all 3 sizes.

• Oversize water course (ideal for conventional and reverse circulation) • Zerk Fitting in stuffing box for simplicity in lubrication of Chevron or V-type packing.

KING OIL TOOLS
P. O. BOX 15146 • HOUSTON 20, TEXAS • ORchard 3-3421



AVONDALE

builder of dual capacity tank barges for the petrochemical industry

The chemical barge shown above, equipped with six tanks and a 10,000 barrel capacity, holds the largest tanks ever designed and built by Avondale. The tanks are specially fitted and valved to hold propane and ammonia in various combinations or separately. Each tank measures 94′0″ by 12′0″, with a working pressure of 260 psi. Avondale's creative engineering and large capacity tank fabricating facilities provide you with the right source to meet your petrochemical requirements. Write for our illustrated brochure, *Marine Construction, Vol. 2.*

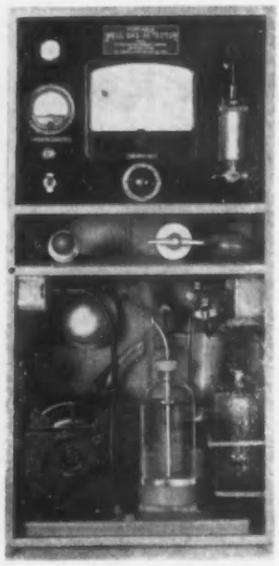
AVONDALE

MARINE WAYS, INC.

VERSATILE BUILDER ON THE MISSISSIPPI

P. O. BOX 1030 • PHONE UNiversity 6-4561 • NEW ORLEANS 8, U. S. A.

EASY LOGGING
WITH THE WELL GAS DETECTOR-LOGGER



$985.00
F.O.B. Houston

This portable automatic Gas Detector-Logger detects and measures continuously gas entrained in the return mud stream. It detects even minute gas shows. The instrument is also equipped for testing cores and cuttings.

The Gas Detector-Logger is built to last for years. It is self-contained in a heavy metal cabinet, 12" x 14" x 27", with hinged door and side carrying handles. The unit includes: a ¼ H.P. motor-driven vacuum pump, gas scrubber and humidifier, core and cutting tester, intensity meter, and portable mud trap and hose, all ready for operation. Use it with a Geolograph or Star Recorder to determine the presence and volume of gas from formation breaks drilled. Every well sitter should have a Gas Detector-Logger.

Weight, 120 lbs. Write for complete details.

PETROLEUM INSTRUMENT CO.
2200 West Alabama, P. O. Box 6252
Houston 6, Texas
"Manufacturers of gas detecting equipment for over 20 years"

"How's that new well coming, Ed?"

A Likely Story

Shocked by the language used by two workmen repairing telephone wires near her house, an old spinster reported the matter to the company. The foreman in making his report on the incident wrote:

"Me and Bill was on the job. I was up the pole and let some hot lead fall which went down his neck. He turned to me and said, 'you really must be more careful, Harry.' and I said, 'Indeed I must, Bill. I will see that it don't happen again.' "

Bible Story

All the animals on Noah's Ark came in pairs, except worms—they came in apples.

Not Advertised as Such

A girdle is an accessory after the fat.

Greener Grass

"I'm not rich like Gillis," he said, "and I haven't got a car or a home like he does, but I do love you and want you terribly."

Two soft snow white arms reached around his neck, and two ruby lips whispered in his ear:

"Where is this man Gillis?"

Arbitrator

The traffic was unusually heavy. A man and a woman driver collided at a busy intersection. A nearby policeman walked over, listened to the dispute, and offered this advice to the man:

"I'd settle if I were you, sir. After all, it's your word against literally thousands of hers."

McCullough puts the shots where they count...®

M-3 GETS PENETRATION AFTER ANOTHER FAILS TWICE*

Another service company made two attempts to perforate this shallow Arkansas well—without results. There was an extra thick cement sheath behind the casing at the perforating interval.

Well was reperforated with 24 improved ½" Ogival Bullets fired by a $5^{7}/_{16}$" OD McCullough M-3 Bullet Gun and is now pumping 10 barrels of oil daily—a normal well for the field.

Depth of operation was 2636'. Casing was 7" OD 20 lb. Operation required 2 hours rig time. Operator was well pleased with results obtained by M-3 Bullet Gun and also with time on job.

McCullough®
M-3 BULLET GUNS

M-3's WILL OUTSHOOT any other bullet guns available. Their greater power has been demonstrated in competitive surface tests, in adjacent wells in the same oil field, and in wells where competition has tried and re-tried, as shown above. M-3's consistently get more oil. They'll penetrate excessive thicknesses of casing and cement and get production—even after others have failed.

M-3's EVENLY SPACED, DEEP PERFORATIONS result from McCullough's exclusive firing method—"simultaneous" progressive pressure firing. Shots are fired very rapidly, progressively from top to bottom, at one firing. The M-3 Gun does not have time to "jump" due to the micro-second firing interval from shot to shot, thus perforating pattern is uniform. There is no damage to casing since all shots are fired progressively.

All "selectively fired" single-shot firing guns will "jump" with each shot fired, producing random spacing and scattering of perforations; unfired shots remaining in a selectively fired gun will develop leaks, dampening of powder loads, and loosening of electrical connections thereby causing inferior penetration for succeeding shots.

***The job described above is certified to be a true field report of service rendered.**

Check these "plus" values you get only in M-3 Guns:

- *Uniform hole spacing in casing—most important to avoid casing damage.*
- *All shots fire progressively—gun at rest in selected zone.*
- *Guns fire one to 6 shots per foot.*
- *Up to 30' of guns may be run at one time, perforating 30' of zone in one run—number of holes per foot desired.*
- *Improved Ogival Bullets give best penetration—proved in steel, Berea Sandstone and through multiple casings.*
- *Strongest, safest gun body made—demonstrated in competitive endurance tests.*

McCullough
TOOL COMPANY
Service Locations in all Principal Oil Fields in U. S. A. and Canada
Service ANYWHERE ANYTIME

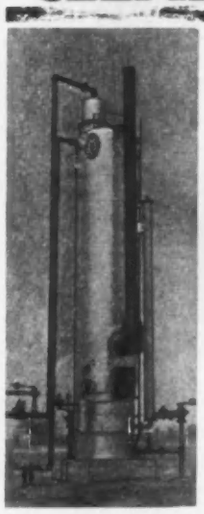
over 20 years"

A girdle is an accessory after the fat.

of liers.

For

CLEANEST OIL



MFD BY M & V TANK COMPANY WICHITA FALLS TEXAS

TYPE P-V PRESSURE TREATERS

M & V TANK COMPANY

Wichita Falls, Texas

TANKS – TREATERS SEPARATORS

Steel Fabrication for the Oil Industry

Specialized

Diner: "What's wrong with these eggs?"

Waiter: "Don't ask me, Bud. I only laid the table."

"This one's coffee . . ."

Commercialized

A wolf is like a modern fluid cleaner—he works fast and leaves no ring behind.

Is This You?

A reckless driver is one who passes you on the highway in spite of all you can do.

An Egotist

A man who thinks that if he hadn't been born, people would want to know why not.

Have a Drink

The termite came into the bar, climbed up on the stool, and demanded, "How's the bar, tender?"

Paying Pains

The patient was worried. "Give it to me straight, Doc. I can take it. How much are you going to charge me?"

Point of View

While the bridge game was in progress, one of the younger women reported about her husband like this:

"He's away from home so much he seems like a stranger when he returns."

"Oh! how thrilling," chirped the older player at an adjoining table.

SECONDARY RECOVERY

Since 1922

PETROLEUM ENGINEERS CABLE & STEPHENS WICHITA FALLS, TEXAS

RESERVOIR ENGINEERING

Water Flooding Gas Repressuring

EVALUATION CORE ANALYSIS

SURVEYS ECONOMICS

Cost Estimates, Design, Installation

FIELD SUPERVISION

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for leakproof, pressure-tight connections

use TiteSeal®

SEALING COMPOUNDS

Heat and vibration-proof, non-solvent, will not shrink, crack or crumble. Makes all assemblies leak-proof and pressure-tight. Prevents rust, corrosion, joint seizure.

7 BASIC BLENDS

LIQUID WRENCH®

The super-penetrating rust solvent

LOOSENS rusted bolts, nuts, screws, 'frozen' parts

Liquid Wrench works *fast*... yet is absolutely safe for all metals and alloys.

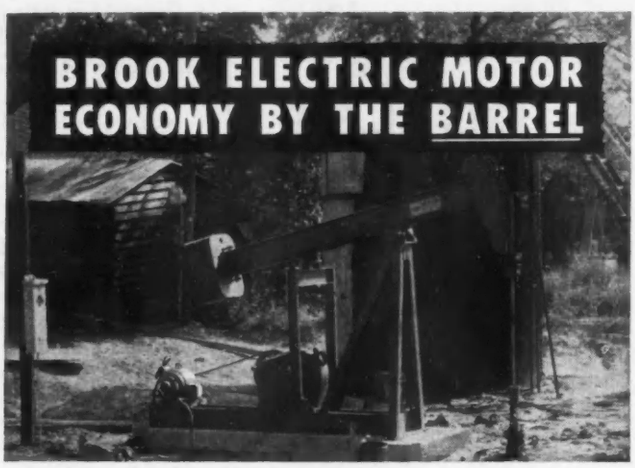
2171

At Industrial, Automotive, Hardware, Plumbing Jobbers

RADIATOR SPECIALTY CO.

Charlotte, North Carolina

SOLDER SEAL



THE less it costs to pump crude the more you make per barrel. Brook A.C. Motors cost less initially and assure maximum service life and overall economy. There is no finer motor built. 1 to 600 H.P. They're powering pumping units from Arabia to Wyoming, stacking up performance records that bring users back again and again for more BROOK MOTORS. Unit shown is a special outdoor pumping service 5 H.P., 1200 R.P.M. Single Phase Motor operating in Texas. Also special drilling motors with three different horsepowers incorporated in one frame. Brook Sales and Service in all producing areas. Send for literature.

SINCE 1904

world's most respected motor

BROOK MOTOR CORPORATION

3553 W. PETERSON AVE, CHICAGO 45, ILL.

In Canada: BROOK ELECTRIC MOTORS OF CANADA LTD., 250 University Ave., Toronto, Ontario

BROOK MOTOR CORPORATION

For more data on advertised products, use Readers' Service Cards, last page.

Genetics

Most children are descended from a long line . . . their mothers once listened to.

Old as You Feel

On the day Joe learned of the birth of his first grandchild, a friend inquired how it felt to be a grandfather.

"It's good news, of course," Joe replied. "But I'll have to get used to the idea of being married to a grandmother."

Hard Sell

A salesman, in trying to sell a refrigerator, pleaded, "Lady, you can save enough on your food bill to pay for it."

"We are paying for a car on the carfare we save," said the woman. "Then, we're paying for a washing machine on the laundry bills we save, and we are paying for a house on the rent we are saving. It looks like we just can't afford to save any more at the present time."

Grrr!

A person who always butts in has an "infuriating complex."

WORLD OIL

"Okay, I'll tell him, but he sure had his heart set on working derricks."

Foot in Mouth

She: "We've been waiting here for a long time for that mother of mine."

He: "Hours, I should say."

She: "Oh, George, this is so sudden."

Pay the Kitty

A small truck loaded with glassware backed out of a factory driveway into the path of a large truck. Most of the glass was broken in the crash, and the driver seemed to be on the verge of tears. A big crowd gathered, and one benevolent old gentleman said compassionately:

"I suppose you will have to make this good out of your own pocket?"

"I'm afraid so," lamented the driver.

"Well, well," said the gentleman. "Here is a dollar for you. Let me pass your hat and I dare say some of these kind people will help you out too."

Over a hundred people dropped bills into the outstretched hat. The driver, stowing the money away as the crowd dispersed, nodded toward the retreating back of the benevolent old gentleman.

"That's what I call a real smart man. He's my boss."

DELTA offers new luxury to the oil industry...

Royal Service

DC-7 FLIGHTS

with *Champagne* dinners

Here is the ultimate in luxury aloft! Three stewardesses assure unhurried, leisurely dining . . . you have a choice of Entrée on many flights . . . select your favorite beverage . . . a special airport passenger agent speeds your check-in . . . there's fast baggage handling and many other special features, all yours on Delta's superb new Royal Service Flights.

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Chicago • Houston
Houston • New York
Dallas • Atlanta
Atlanta • Houston
and other cities

Delta AIR LINES

Call Delta or your Travel Agent

GENERAL OFFICES: ATLANTA AIRPORT, ATLANTA, GEORGIA

For more data on advertised products, use Readers' Service Cards, last page.

250 University Ave., Toronto, Ontario

From Liberty Mutual: a concept of workmen's compensation coverage for today's economic conditions which provides

Protection in

—and how it cuts excess dollars from compensation insurance costs

The business-insurance rates you pay are, in the long run, determined by you

In today's business climate, it's more important than ever for you to keep your expenses down. If you have a large number of accidents, however, or suffer heavy losses over a period of time, you actually contribute to higher insurance rates for yourself. By doing everything you can *right now* to cut down on accidents and eliminate losses, you can help toward lowering your rates *in the future* – and help improve your company's profit picture.

This is why Liberty Mutual – the company with the largest experience in workmen's compensation insurance – has over the years developed a forward-looking concept of business insurance which gives you protection in depth. From the start of your coverage, a broad range of skills and resources can be put to work to anticipate and avoid trouble on your drilling sites and to keep future costs down.

Today, more than ever, *PROTECTION IN DEPTH* can be vital to the growth of your business

With competition so strong in the oil-well drilling industry, it is apparent that the vigorous, efficiently managed companies will become the industry leaders of tomorrow. The protection in depth you get from Liberty not only helps you trim excess dollars from your insurance costs, but does it without sacrificing any of the coverage you need to safeguard your company during its growth.

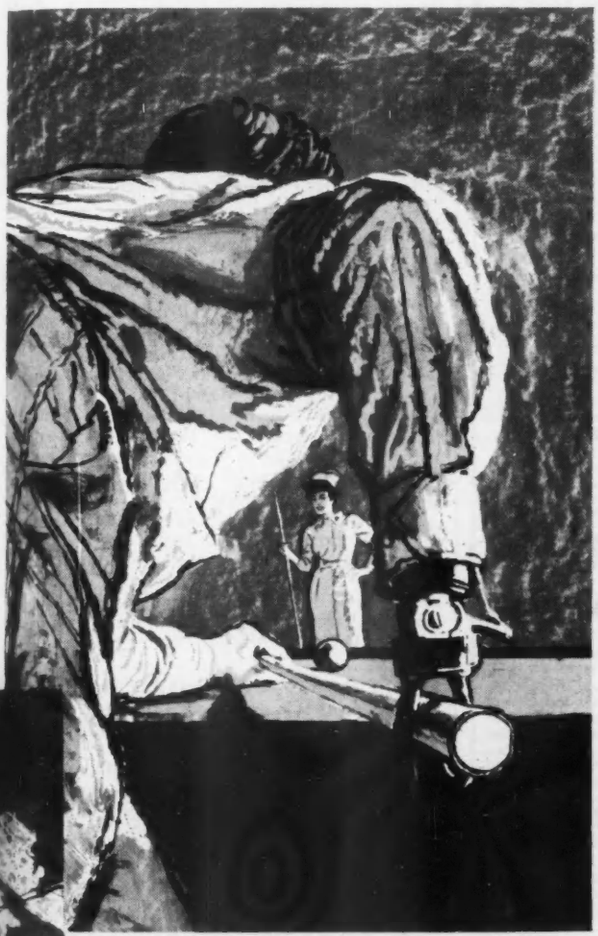
Protection in depth has already helped Liberty establish an impressive cost-cutting record and a record for consistently attracting "blue-chip" accounts. Because we deal directly, our salesmen know their business – and yours. With the vast experience of the company behind them, they can competently handle unusual problems in all fields.

We encourage you to take steps to improve your insurance cost picture by becoming acquainted with protection in depth now. (You should also know about our dividends: since 1912, we have returned more than $455 million to reduce policyholders' insurance costs.)

218 For more data on advertised products, use Readers' Service Cards, last page. WORLD OIL DECEMBER, 1958

depth

New look at injuries—new savings. In 64 areas of the country, Liberty retains leading specialists to check the diagnoses of serious cases and assist treating physicians. Result to policyholders: lower compensation costs.



Rebuilding injured men through prosthetics, physical and occupational therapy is the function of Liberty's two rehabilitation centers. Badly injured employees of policyholders help themselves recover, get back on the job and off compensation.

Finding trouble before it happens. Liberty's loss-prevention engineers visit your rig, spot hazards, suggest ways to eliminate them. Result: fewer lost-time accidents, lower insurance costs in the future.

The broad range of Liberty's special skills and resources protects four vital areas

From Liberty's protection-in-depth resources — many unique in the insurance business — has come a new, 4-way insurance program for oil-well drillers. This program can save you money, assure you of protection in depth in four important areas. Here's what it does:

Protects your rig. Gives you realistic coverage against fire, wind, explosion, blowout, collapse and many other disasters. Loss-prevention engineers work with your crew, help spot accident hazards, give money-saving recommendations.

Protects your men. We help you set up your own on-the-rig medical program. Our hygienists check working conditions, and when accidents do happen, our claimsmen assure speedy medical care.

Protects your fleet. Safeguards you against damage to your trucks and company cars, and against crippling lawsuits for liability.

Protects your company. Drilling-site hazards to the public are great. Jury awards for bodily injury can put a driller out of business. Our Public Liability coverage protects your company against this kind of trouble.

Pictured on these pages are some of the many "extras" that put teeth into this 4-way protection-in-depth program. All of them are available to any policyholder who needs them.

Look for more from

LIBERTY MUTUAL

...the company that stands by you

LIBERTY MUTUAL INSURANCE COMPANY • LIBERTY MUTUAL FIRE INSURANCE COMPANY • Home Office: Boston
Insurance for: Automobiles, Liability, Group Accident and Health, Fire, Workmen's Compensation, Marine, Crime

WORLD OIL'S Trading Post
CLASSIFIED ADVERTISING

RATES: Regular Classified (undisplayed) set in this size type: 20 cents per word. Minimum charge $4. Blind box address in our care counts six words. Replies forwarded without charge. **Display Classified ads,** set in suitably larger type with ruled border, $13.50 per column inch. Ten percent discount for two or more insertions of same copy in consecutive issues. **All classified ads payable in advance.** Send copy and checks to: Trading Post Classified Section, World Oil, P. O. Box 2608, Houston, Texas.

BUSINESS SERVICE

■ Combination General Manager, Drilling Superintendent, and Petroleum Engineer, to supervise foreign one rig operation; top salary and bonus. We want complete background and references. All replies held strictly confidential. Box 174-W, WORLD OIL, Houston, Texas.

SITUATIONS WANTED

■ Exploration Geologist-Geophysicist, B.S. Math, M.S. Geology, 33. Eleven years seismograph and sub-surface interpretative experience in the Gulf Coast. Supervisory experience. Box 178-W, WORLD OIL, Houston, Texas.

■ Production or work over foreman three years college, 27 years experience, 16 years in secondary recovery. Box 180-W, WORLD OIL, Houston 1, Texas.

■ "I am a senior in the School of Petroleum Engineering of the University of Oklahoma. I expect to graduate in January, 1959, and am looking for a position. I speak English, German and French fluently, and have a working knowledge of Spanish. I am especially interested in working abroad. Date of availability is February 15, 1959." Box 177-W, WORLD OIL, Houston, Texas.

PILOT. Presently employed desires change. Age 39. Married, two children. Owns home. Airline transport rating with commercial privileges on multi & single engine land craft.
5,000 accident-free hours in DC-3's, DC-18's, 310's and Navions. 400 actual instrument hours. U.S.A.F. reserve on flight status. Some sales experience. Salary open. References & complete resume available. Box 179-W, WORLD OIL, Houston, Texas.

LEASES

■ U. S. DEPARTMENT OF THE INTERIOR, Bureau of Land Management, Washington, D. C. Notice is hereby given that approximately 48.5 acres of land comprising the Veterans Administration Center Reservation in Shreveport, Caddo Parish, Louisiana, will be offered for oil and gas leasing through competitive bidding to the qualified bidder of the highest cash amount per acre at 1:00 P.M., E.S.T., December 17, 1958, when bids will be opened. Details of the lease offering, how and where to submit bids, may be obtained from the Geological Survey's Oil and Gas Supervisor at 239 Federal Building, Tulsa, Oklahoma, or the Conservation Division, General Services Administration Building, Washington 25, D.C., and from the Minerals Staff Office or the Eastern States Land Office, Interior Building, Washington 25, D.C., Edward Woozley, Director.

FOR SALE

NEW CASING
MILL PRICE—LESS 10%

3600'–7" 23#–LT&C–N-80, R-3
800'–7" 26#–LT&C–N-80, R-3
3700'–7" 29#–LT&C–N-80, R-3
600'–7" 32#–LT&C–N-80, R-3
9000'–2⅞" 6.5#–T&C–N-80, R-2

All API Youngstown Seamless In Perfect Condition

ROTHSCHILD OIL COMPANY
Phone RAymond 3-3357
Santa Fe Springs, California

FOR SALE

1959
OIL DIRECTORIES

16 pocket-size, plastic-bound personnel directories covering the entire oil industry of the world, from top executives to foremen. Over 110,000 key men are listed. First eight book cover Producing and Drilling Contracting.

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7. Rocky Mountain Region and New Mexico
8. Oil Well Drilling Contractors (Covers the World).
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10. Refining, Petrochemical, and Natural Gas Processing Plants of the World
11. Pipe Line Companies and Pipe Line Contractors (Covers the World)
12. Oil Directory of Companies Outside the U. S. A. and Canada
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14. Directory of Geophysical and Oil Companies Who Use Geophysical Service
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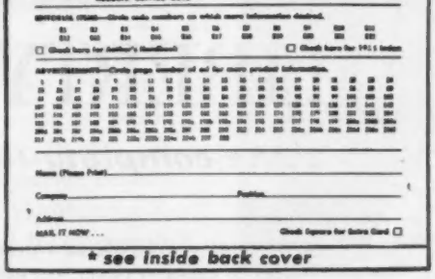


*** see inside back cover**

New Books, Maps and Movies

PRINCIPLES AND PRACTICE OF FLOW METER ENGINEERING, The Foxboro Company, Foxboro, Mass., L. K. Spink, $15.

In the eighth edition of "Principles and Practice of Flow Meter Engineering," the author has included the latest developments in flow measurement, making the new text the largest, most complete and authoritative book to be published on flow meter engineering.

This review was published in the October issue of WORLD OIL and incorrectly listed as a free literature item.

THE OILMAN'S BARREL, The University of Oklahoma Press, Norman, Okla., by Robert E. Hardwicke, $3.75.

The seemingly insignificant unit of measure of oil, the barrel, has an interesting history behind it. The author, associate and chief counsel for the Petroleum Administration for War during World War II and now a Fort Worth, Texas, attorney, did extensive research into the history, definitions and legal pitfalls involved in the standard oil barrel.

The book has important meaning for historians, meterologists, petroleum lawyers and executives, coopers, distillers and the petroleum industry generally.

REPORT ON IGNEOUS ROCKS OF THE WESTERN PART OF THE WICHITA MOUNTAINS, The University of Oklahoma, Norman, Okla., by Dr. Clifford A. Merritt.

Printed as a bulletin of the Oklahoma Geological Survey, the report deals with the Lake Altus area. This area covers approximately 300 square miles in Greer and Kiowa counties in southwestern Oklahoma.

The igneous rocks are exposed as groups of mountains, hills and knobs which rise abruptly above the surrounding plain of Permian red beds. With the cooperation of geochemists of the Carnegie Institution positive ages were obtained by analysis of radioactivity in mica.

EXPLORATION GEOPHYSICS, Trija Publishing Company, 2500 West Coast Highway, Newport Beach, Calif., by Dr. J. J. Jakosky, $12.50.

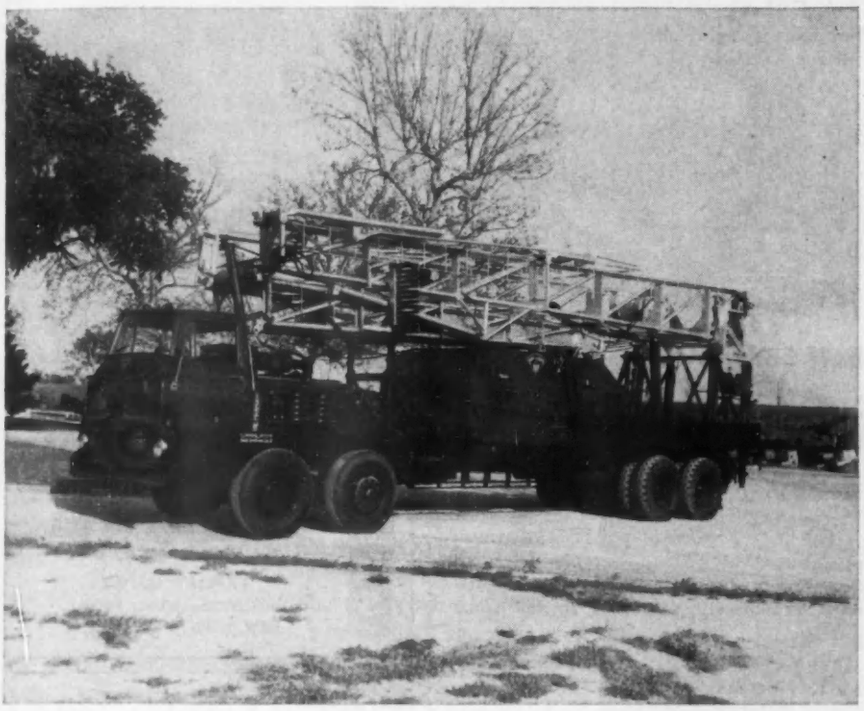
Engineers, geophysicists and others concerned with geophysical exploration techniques will be especially interested in the newly printed, revised edition. Dr. Jakosky, has worked with 39 other authorities in developing and writing the book. With over 1,200 pages and 715 illustrations, "Exploration Geophysics" covers every phase of modern exploration methods, even including such subjects as permit, trespass and insurance problems.

DIRECTORY OF GEOLOGICAL MATERIAL IN NORTH AMERICA, American Geological Institute, 2101 Constitution Ave., Washington 25, D.C., $3.

This new edition was prepared by J. V. Howell and A. I. Levorsen with the assistance of Robert H. Dott and Jane W. Wilds. This publication contains 208 pages and lists sources of maps, reports, well records, libraries, museums and other important data available in each country of North America and each state and territory of the United States.

What's New in EQUIPMENT and SERVICES

Drilling - Production - Exploration



New Mobile Servicing Unit

A self-propelled well servicing unit has been announced by Fred E. Cooper, Inc.

The servicing unit was designed for optimum mobility and efficiency and is being used in the oil fields of Wyoming, south Texas and the Gulf Coast area.

The unit, engineered for proper loading distribution and dimensional size, meets highway regulations and is operational in all areas without special permits.

In the development of the new rig many factors were considered, foremost being ease of operation, legal mobility and simplicity of construction.

(This item supplements Fred E. Cooper, Inc., data on Pages 1389-1408 of the Composite Catalog, 22nd Edition).

For more data, circle **No. E1** on Readers' Service Card, last page this issue.

Surveying Instrument

This small, lightweight surveying instrument, known as Geodimeter Model 4, is offered by The Geodimeter Company, Division of Ber, Hedstrom and Company, Inc.

It is especially designed for short distances of up to 3 miles. It is only 12 inches square, weighs 35 pounds and is recommended for use in rough terrain.

The following tasks can be readily handled through its use:

1. Photogrammetry and traversing on short lines.

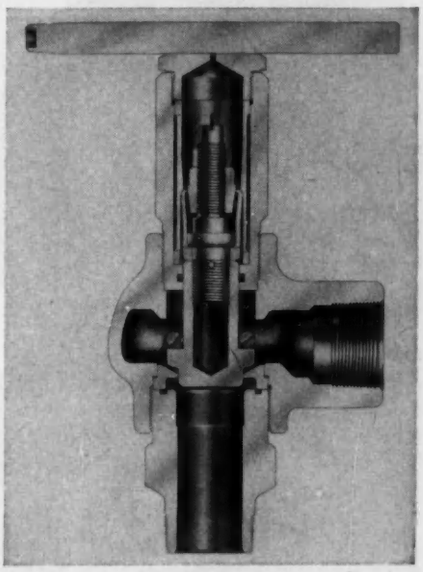
2. Road and pipe line right-of-way layout and staking.

3. Oil field and seismic surveying surveys.

4. Calibration of short range radar.

This model employs a modulated light beam that is reflected in pre-established, unmanned reflectors stationed at the unmeasured points. The narrow reflected light beam enters a phototube which converts light into electrical energy. Readings are obtained by nulling a meter by means of a graduated knob.

For more data, circle **No. E2** on Readers' Service Card, last page this issue.



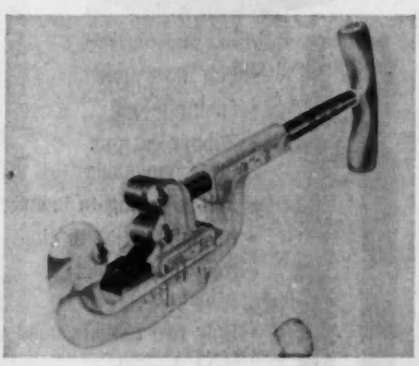
Relief Valve

New Kinzbach Model 115 relief valve is a positive action piston-type shutoff relief valve that provides instantaneous full capacity relief for installations where a manually reset valve is applicable.

A bumper ring assembled on the quick opening piston completly protects the valve from high pressure impact of the piston on the body and restraining elements. Adjustable restraining elements allow infinite pressure settings within the valve's range.

(This item supplements Kinzbach Tool Co., Inc., data on Pages 2873-2892 of the Composite Catalog, 22nd Edition.)

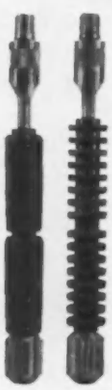
For more data, circle **No. E3** on Readers' Service Card, last page this issue.



Pipe Cutters

Another addition to its line of quality pipe tools has been recently made by The Toledo Pipe Threading Machine Company. A new line of pipe cutters, designed

BJ SWABS



- Pull more fluid
- Faster falling
- Rubber designs interchangeable
- Self-adjusting to loads
- No ball & seat to clog
- New field-proved principle
- Only two rubbers needed

Sold through supply stores

CUP TYPE DISC TYPE

Byron Jackson Tools, Inc.

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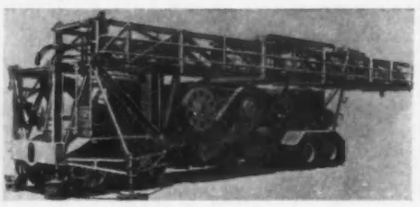
Los Angeles Houston

to give cleaner, straighter cuts than ever before, according to the manufacturer, is now in production.

A new form-fitting handle, deigned to fit the hand, and the sturdy malleable frame, are claimed to lengthen the life of these new cutters. Other improvements include a new high-alloy steel cutting wheel, new sliding block construction, new replaceable slide plate, and a longer shank to protect the threads.

For more data, circle No. E4 on Readers' Service Card, last page this issue.



Self Contained "Travelrigs"

Cardwell Manufacturing Company announces the development of a series of self contained "Travelrigs."

The Travelrigs will aid contractors and producers alike in servicing rigs from an unusual and unique angle.

The new rigs were planned for "drive-in" operation. The operator simply drives directly up to the well location—head on—and immediately goes into rig-up procedure.

With these new servicing units, the contractors can expect to:

1. Lessen trip time from yard to well location.

2. Reduce rig-up time.

3. Shorten trip time by making available more power through the hoist.

This will permit the contractors to offer a good hourly rate.

(This item supplements Cardwell Manufacturing Company data on Pages 1213-1276 of the Composite Catalog, 22nd Edition).

For more data, circle No. E5 on Readers' Service Card, last page this issue.

Fluid Control Needle Valve

A new line of fluid control needle valves for high pressure, high temperature conditions has been announced by The Imperial Brass Mfg. Company. Equipped with tubing connections, the line was engineered for satisfactory operation under working pressures up to 5000 psi, in temperatures ranging from —60° F. to +450° F.

Trouble free inert Teflon packing which is not affected by synthetic hydraulic fluids is used for positive sealing. Accurate throttling, with a minimum of torque needed for valve operation, even under high pressures, is achieved by use of a fine pitch stainless steel stem with single thread, combined with a long stem taper.

For more data, circle No. E6 on Readers' Service Card, last page this issue.

INCREASE PRODUCTION

CLEAN OUT CHOKING SAND

Excessive sand and sediment holds back your oil. For fast, easy clean out with fewer round trips and less down-time, use world famous Miller Sand Pumps.

SAND PUMP SIZES

O.D.—2½, 3, 3½, 4¼, 5, 5½, 7 in.
Lengths—20, 25, 30 ft.

Composite Catalog, Page 3419

Write for descriptive price list

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FORT MORGAN, COLORADO—C. A. White 919
GLENDIVE, MONTANA—C. A. White ..... EM 5-3833
HOBBS, NEW MEXICO
Horne Well Service Co. 3-5396
HOUMA, LOUISIANA—Cameo, Inc. 7335
HOUSTON, TEXAS
Assoc. Eng. & Equt., Inc. ..... CA 5-1188
HOUSTON, TEXAS
Mid-Western Well Ser. Co. ..... RE 4-4282
LAFAYETTE, LOUISIANA
Assoc. Eng. & Equt., Inc. ..... CE 5-6779
Cameo, Inc. ..... CE 5-3124
LIBERAL, KANSAS—Rainbo Service ..... Main 4-3586
MIDLAND, TEXAS
Lucgese Service & Equt. Co. ..... MU 2-1631
NEW ORLEANS, LOUISIANA
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ODESSA, TEXAS
Cameo Wire Line Service, Inc. ..... FE 2-6407
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Rainbo Service Co. ..... ME 4-2131, ME 4-9106
PASADENA, TEXAS
Long Line Production Control ..... GR 1-5789
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Eddie Jones Eng. Co., Pettus 16, Beeville, FL 8-1218
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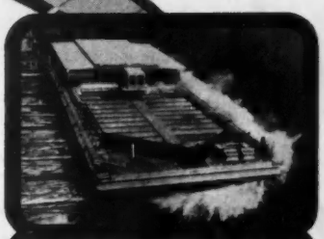
The new corrosion film everyone is talking about!

Here is an authoritative film that answers many questions on the theory of corrosion and demonstrates methods by which it is controlled. Presented in color and sound, it ranges from the formation of anodes and cathodes through the use of galvanizing, inhibitors, metallizing, cathodic protection, alloys and protective coatings. You will see how many corrosion problems in industries such as yours are being solved by Dimetcote, a one-coat zinc silicate protective coating. This film will be well worth 19 minutes of your time. To arrange a showing for you and your associates, or to learn when it will be shown in your area, contact any of the Amercoat offices listed below.



Typical audience reactions:

Bishop, Tex.—"Planning fair-sized test after seeing this film."

Louisville, Ky.—"Answers many questions. Second showing arranged."

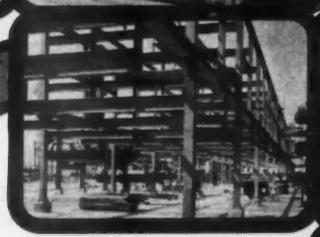
Cincinnati, Ohio—"Key personnel evidenced considerable interest."

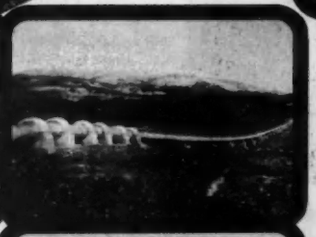
Netherlands Antilles—"Both shows led to 45-minute discussions."

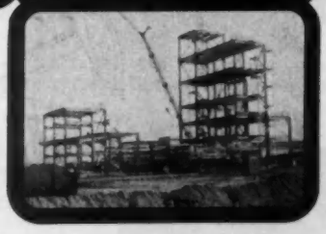
Fairport, Ohio—"Very interesting. Will try methods shown."

Las Piedras, Venezuela—"Putting ideas to work in near future."

Bartlesville, Okla.—"Viewed by 42 key men from five divisions."







Answers these and other questions:

What produces electrolytic corrosion?

What factors favor hot-dip galvanizing?

How important is surface preparation?

Can a coating survive a tank fire?

Can rust in tankers be controlled?

Can a coating offer cathodic protection?

What are the corrosion problems on offshore rigs?

What are the advantages of zinc silicate?

How can chemical plants cut painting costs?

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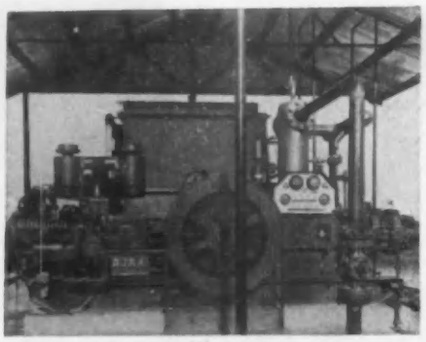


Heavy Gas Compressors

Ajax Iron Works announced the release of the first of a new line of horizontal, opposed-cylinder gas engine-compressors, designed around the familiar Ajax oil field gas engines.

Among the many design and construction innovations built into the new DPC-230 compressor is the massive four-throw crankshaft, mounted on three double-row, tapered roller main bearings which are permanently adjusted at the factory, having engine throws of greater length than for the compressor side. This arrangement permits piston speeds for optimum efficiency of the compressor while obtaining maximum power and fuel economy from the power side.

(This item supplements Ajax Iron Works data on Pages 138-139 of the Composite Catalog, 22nd Edition).

For more data, circle **No. E7** on Readers' Service Card, last page this issue.

Free Flow Tools

Oil Well Cementing Co. Inc., recently introduced their free flow combination tools for service in squeeze cementing, fracturing, acidizing, casing testing, casing perforating and collar locating. The new FFC tools are made for work in wells with size range of 4¾, 5½, 6⅝, 7, 7⅝ and 8⅝ inches.

The collar locator and casing perforator are used with the FFC packer as shown in illustration. The FFC packer is full opening to API tubing sizes which permits thru-tubing services to be performed.

The collar locator permits the operator to make collar log either going in or coming out of hole with drill pipe or tubing and accessory tools attached. Locate any collar any time as often as desired.

Oil Well Cementing Co.'s casing perforator is the expendable type and can be inserted in drill pipe or tubing at surface and pumped down the well with rig pump or cementing unit. The perforator is actuated entirely by hydraulics and cannot be accidentally fired on the surface. It is possible to shoot as many or as few holes as desired during each run, and progressive perforating is now possible with a very minimum of delay.

For more data, circle **No. E8** on Readers' Service Card, last page this issue.

Electric Valve Positioner

A new, all-electric positioner that eliminates the need for auxiliary hydraulic and pneumatic valve-actuating systems has been announced by Norwood Controls Division of American Standard Products.

Designed to operate from most standard electric controllers, the new positioner is powered by a 1/40 hp. two-phase induction-type motor which drives the actuating shaft through a highly efficient gear train and ball-screw mechanism.

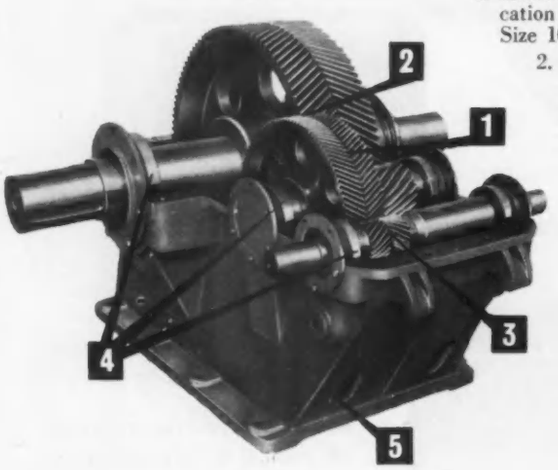
Transistorized and explosion-proof, Norwood's positioner can be manually operated in case of power loss. A unique braking system prevents valve oscillation and ensures repeatability to within ¼ percent.

For more data, circle **No E9** on Readers' Service Card, last page this issue.

The Heart of a Pumping Unit is its GEARBOX...

. . . a tough, hardworking body must have a sound heart . . . This is why Le Grand gives top priority to sound material and accurate workmanship.

Five of the features that make them so trouble-free are:—



1. Manufactured to A.P.I. Specification in full range from A.P.I. Size 10 to A.P.I. Size 640.
2. Double-Helical, Double-Reduction Gears made from Nickel-Chrome and Chrome-Moly Alloy Steel; 30:1 Ratio.
3. First Reduction Gear Train—Single Wheel and Pinion on smaller sizes; Split on Sizes 320 and larger. Conforms to standard practice.
4. Bearings all Location Type, Heavy-Duty Roller or Ball.
5. Sloping inside base controls oil capacity and stiffens case.

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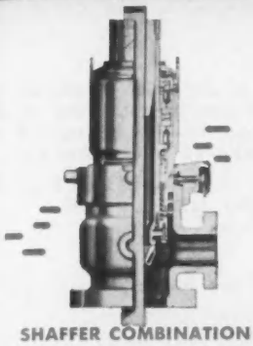
When it comes to pressure control...

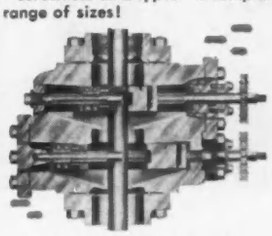
Come to SHAFFER!

Shaffer pressure control equipment is the top choice of leading operators throughout the Oil World because Shaffer equipment embodies unique advancements found in no other line of pressure control equipment... advancements that assure easier, more positive operation and quicker, simpler servicing. Add to this the fact that Shaffer is *quality* equipment throughout, built to the highest standards of safety, long life and low maintenance... and is available in a choice of sizes, and types to meet virtually every field condition and pressure requirement... and you will see why Shaffer leads the industry in pressure control. Take these typical products, for example...



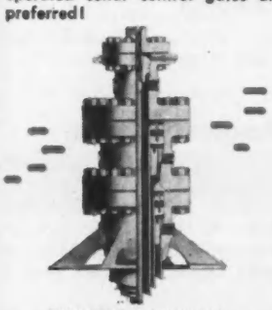
SHAFFER COMBINATION ROTATING BLOWOUT PREVENTERS AND STRIPPERS

- Combine in one unit every necessary feature for complete pressure control while drilling.
- Maintain continuous seal around any element in the drill string, drill pipe, tool joints, kellys, drill collars, and couplings—*automatically*, whether string is rotating, being raised or lowered, or is stationary.
- Can be used with any standard kelly (square, hexagonal or octagonal)—and any type of drill pipe (coupled, upset or flush). No special drill string is required!
- Quick-Releasing Bonnet permits passing bits, reamers, other large-diameter tools through the unit quickly and easily.
- Available in 2 types—a complete range of sizes!



SHAFFER MECHANICAL CELLAR CONTROL GATES

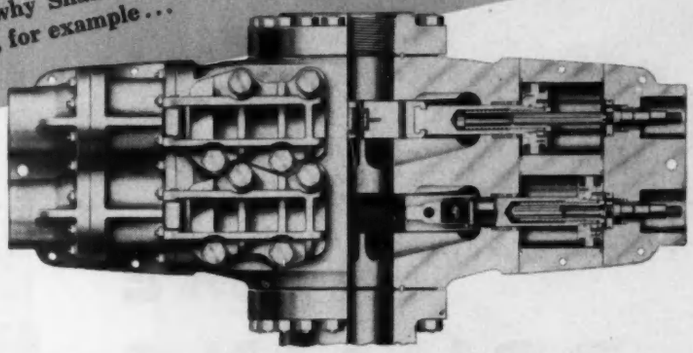
- Available in both *Double* (illustrated above) and *Single* types for operation by an air motor drive utilizing the air supply available at most rigs—*plus the protection of manual standby!*
- Even in sizes as large as 13⅜" (12" Series 900) the Double type requires less than 29" cellar height, the Single less than 17½"!
- Rams are changed by simply removing one end cover... quick draining ram compartments prevent accumulation of deterimental mud and sand... many other unique features make these gates top choice wherever *mechanically*-operated cellar control gates are preferred!



SHAFFER LANDING, CASING AND TUBING HEADS

- Meet every requirement for modern, compact, casing and tubing suspension in wells of all depths.
- Available in various types and packing arrangements. Base Heads and Combination Base, Casing and Tubing Heads are available for combining several units into one where space is at a premium.

Shaffer also provides a complete line of modern Tubing Heads, Multiple Zone Hook-Ups and other control equipment for your landing, casing and tubing strings.

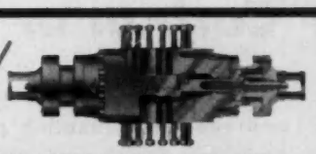


SHAFFER HYDRAULIC CELLAR CONTROL GATES

- Available in Both *Double* (illustrated above) and *Single* types. Both in choice of *Non-Rising* Locking Shafts (for those preferring maximum compactness) and *Rising* Locking Shafts (for those preferring quick indication of ram position.)
- They provide unequalled simplicity in changing rams. Simply unbolt two doors, change rams, close and bolt the doors. Rams are automatically aligned as the doors are bolted shut!
- They save cellar space. Even in sizes as large as 13⅜" (12" Series 900), the Double Gate (with *two* ram compartments in *one* body) is only 30" high...and the Single only 18½" high (Smaller sizes are even less)!
- Still other exclusive features—such as Direct Hydraulic Drive, Completely Enclosed Design, Quick-Draining Compartment Bottoms...make Shaffer Hydraulic Cellar Control Gates the outstanding choice of the industry.

They are available in a complete range of sizes and pressure ranges.

New!



SHAFFER XHP HYDRAULIC GATES

Large-Bore Preventers for Extra High Pressures!

Shaffer's new XHP Hydraulic Gates are not only in full production, but many are in actual field service, establishing advanced standards of pressure protection where unusually high well pressures are encountered.

- **XHP equipment features a unique hinged body design that greatly simplifies ram changes and maintenance!**
- **Fluid lines are machined directly into the hinge pins so body can be swung open without breaking any fluid connections!**
- **Three bore sizes are available—7 1/16" bore for *working* pressures to 15,000 PSI—9" bore and 11" bore for *working* pressures to 10,000 PSI!**

Write for new bulletin that provides full details on Shaffer XHP Preventers!

IN ADDITION, Shaffer provides the industry's most advanced line of Adjustable Flow Beans—the units that pioneered the adjustable flow bean principle and are still unequalled in efficiency. They are available with Conical, Micro and electrically-heated Thermo Tips, in both regular and hard-metal designs to meet a wide range of drilling, production and refinery applications. Both flanged or screwed connections—in a wide choice of popular sizes!

Send for the complete Shaffer Catalog which describes these and other Shaffer Pressure Control Products!

35 years OF OIL TOOL LEADERSHIP

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OKLAHOMA CITY, OKLAHOMA, Shaffer Tool Works, 6201 South Shields Boulevard
FARMINGTON, NEW MEXICO, Shaffer Tool Works, Post Office Box 1788
CASPER, WYOMING, Shaffer Tool Works, Post Office Box 827
HOUMA, LOUISIANA, Shaffer Tool Works, 500 Fifth Avenue, New York, N. Y., U.S.
EXPORT SALES OFFICE, Shaffer Tool Works, 500 Fifth Avenue, New York, N. Y., U.S.

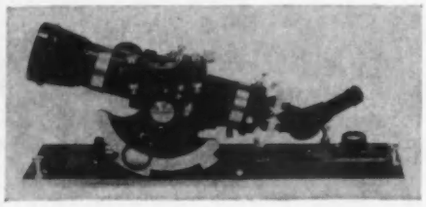
Polish Rod Packing

Axelson Manufacturing Co., Division of U.S. Industries, have announced a new Marlo improved polish rod packing, exclusively designed for Hercules stuffing boxes under the Marlo patents, is now available.

The new Marlo packing offers many inherent advantages which have proved to be derived from basic advances in packing technology.

(This item supplements Axelson Manufacturing Co., Division of U.S. Industries, Inc., data on Pages 371-374 of the Composit Catalog, 22nd Edition).

For more data, circle **No. E10** on Readers' Service Card, last page this issue.

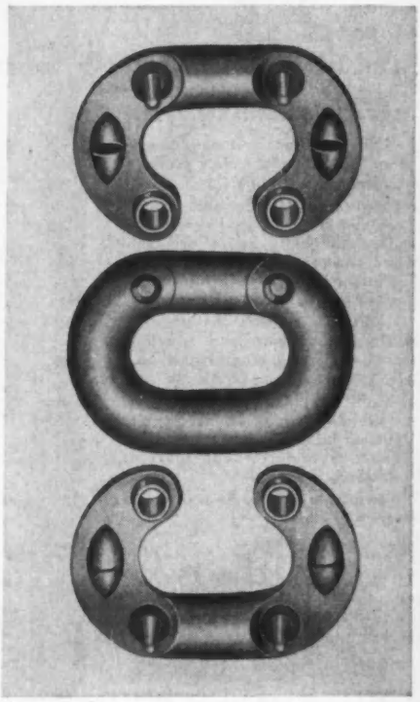


Elbow Eyepiece

A new elbow eyepiece has been added to the Gurley Alidade, it has been announced by W. & L. E. Gurley.

The eyepiece was developed to fill the need for an instrument which will be easier to read in the field. It extends in a diagonal direction from the end of the Alidade telescope. It can be rotated in any position and read from either side.

For more data, circle **No. E11** on Readers' Service Card, last page this issue.



Chain Connectors

Connecting hooks, swivels or rings to chain, or repairing chain, is now done quickly and easily with the Crosby-Laughlin Missing Link. In a few seconds the halves of Missing Links are joined simply by peening together. The resulting connection is stronger than welding, safer than cold shuts or cast links.

The drop forged, heat-treated halves of the Missing Link have integral rivets and interlocking lugs which evenly distribute the load throughout the link when joined.

(This item supplements Crosby-Laughlin Division, American Hoist & Derrick Co. on Pages 1414-1415 of the Composite Catalog, 22nd Edition.)

For more data, circle **No. E12** on Readers' Service Card, last page this issue.

Seismic Magnetic Tape

A seismic-magnetic media transcriber, tradenamed Omnitape, has been developed by Hale Instruments, Inc. This instrumentation is available to the seismic industry for the express purpose of standardizing all types of magnetic tapes and discs now in popular use.

The Omnitape permits you to transcribe the seismic data from one major tape or magnedisc to any other tape or disc without the loss of record fidelity. This is accomplished with a single playback head transcribing one trace at a time to a single recording head, with the heads automatically moving over to the next trace on the respective tapes.

For more data, circle **No. E13** on Readers' Service Card, last page this issue.

There is more than meets the eye in...

ACME DRILLING JARS

Carbon or Alloy Steel

You can't see the higher quality steels and the controlled heat treating procedures that help make Acme jars last longer. Nor can you see the experience and integrity that stand behind these Acme products.

But you can see the Acme trademark—the stamp that means these jars have passed many exacting tests of quality control.

Acme offers two types of drilling jars—CARBON STEEL, first choice with many drillers and ALLOY STEEL, for extra footage and longer life.

Both type jars are warranted for a specific amount of wear—NO time limitation on the warranty.

Sold through dealers everywhere

ACME FISHING TOOL CO.
Box 860 — Dept. 10
PARKERSBURG, WEST VIRGINIA

Another reason why it pays to buy the pipe with the...

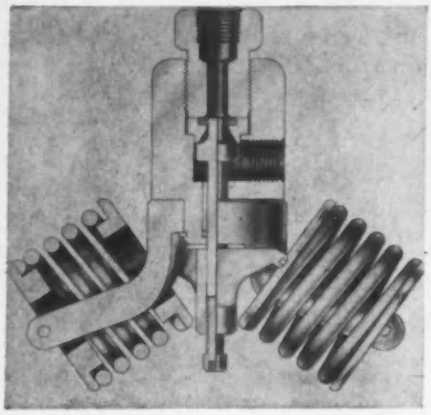
Orange Bands

PERFORMANCE PROPERTIES AND SETTING DEPTHS

LIGHTWEIGHT GRADE E DRILL PIPE

SIZE (OD)	INCHES	2⅞"	3½"	4"	4½"	5"
Weight*	Lb./Ft.	6.85	9.50	11.85	13.75	15.0
Wall Thickness	Inches	.217	.254	.262	.271	.296
Tension Data (Minimum Values)						
Load at Minimum Yield	Lbs.	135,900	194,270	230,760	270,030	328,070
Equivalent Length	Ft.	19,840	20,450	19,480	19,640	21,870
Collapse Data (Minimum Values)						
Collapse Pressure	PSI	8,380	8,080	7,080	6,290	6,140
Setting Depth (S.F. = 1¼)	Ft.	14,900	14,370	12,590	11,180	10,920
Internal Pressure at Minimum Yield	PSI	9,980	9,600	8,660	7,900	7,830

*Tentative API Weights



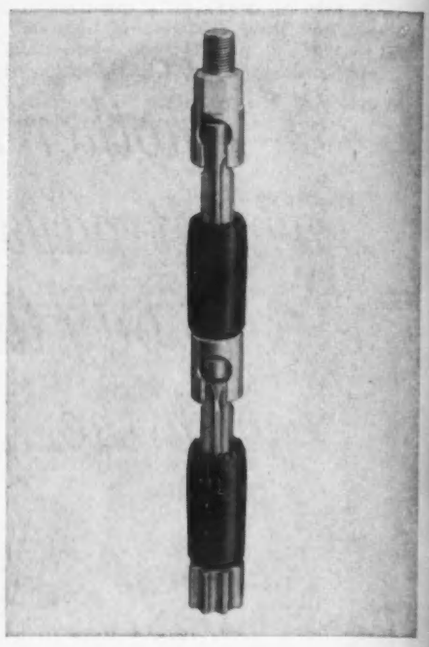
High-Pressure Relief Valve

A snap action, high-pressure relief valve, Model 117, for protective use on repressuring pumps, hydraulic power service, hydraulic pumping units, hydrostatic test systems and many other oil field applications, is announced by Kinzbach Tool Company, Inc.

Uniquely functional in design, a variety of pressure and capacity relationships are available with basic components common to several assemblies. Available in ¼ NPT to ¾ NPT sizes.

(This item supplements Kinzbach Tool Company, Inc., data on Pages 2873-2892 of the Composite Catalog, 22nd Edition).

For more data, circle **No. E14** on Readers' Service Card, last page this issue.



Knuckle-Joint Tubing Swab

The Guiberson Corporation, one of the Dresser Industries, has announced a new knuckle-joint tubing swab. Design is such that cups may be changed without tools in only 10 seconds, on the floor or in the derrick. It is not necessary to lay the swab and sinker bars down, and no pipe wrenches or tools of any kind are required. The swab may be quickly and easily converted to a multi-cup swab by merely adding an upper mandrel and cup for each extra cup desired.

The upper mandrel is keyed so that knuckle-joint sockets are held in line; and, regardless of how many cups are added, it is impossible for the swab to jack-knife and disassemble accidentally, Swivel-knuckle action of the ball and socket joints allows a fast fall, even in crooked tubing.

For more data, circle **No. E15** on Readers' Service Card, last page this issue.

when the $64,000. QUESTION is MUD...

You'll win more than this prize. You'll increase drilling efficiency and control your mud better. Mud-O-Graf records every variation in mud weight, saving time and costly errors in the addition of weighting materials. All heavy and light streaks in the circulating system and their duration are recorded. Mud-O-Graf shows how often the hole is filled up when coming out of the hole and shows the time of a complete circulation. If it's a question of mud, ask for Mud-O-Graf.

WARREN AUTOMATIC TOOL CO.

Manufacturers of Pit-O-Graf and Rig Runner.

3915 Tharp St. Houston CApitol 4-2511

Lake Charles, La. HEmlock 6-2265 | New Iberia, La. EMerson 9-9862 | Harvey, La. FOrest 6-1441

Cement Transport Trailer

A cement transport trailer unit of larger capacity and different design has been introduced by BJ Service, Inc., for use in the oil well cementing operations.

Named the 700 ST, the trailer unit has an increased payload capacity of 590 sacks of cement and is designed to increase operational efficiency by a substantial margin.

For more data, circle **No. E16** on Readers' Service Card, last page this issue.

Some of National Tube's most notable contributions to the oil industry:

National Deoxidized Bessemer Steel Casing and Tubing—Grades H-40, J-55. Especially well suited for oil production because of its combination of high yield strength and good ductility.

National Warm-Worked Casing—Grade N-80. An extremely high-strength casing possessing a uniformity of physical properties which gives it high collapse resistance and greatly increased joint strength. It is hydrostatically tested to 80% minimum yield strength up to a maximum of 10,000 psi.

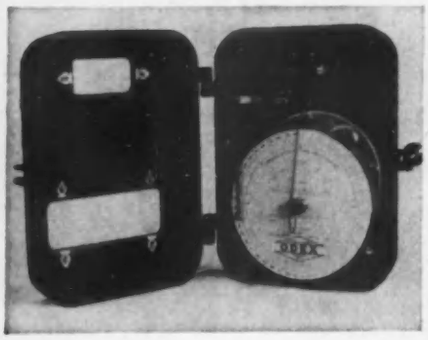
National Deep-Well Casing—The strongest casing produced under API specifications to meet constantly increasing depths. Due to the severe service for which it is intended, it is hydrostatically tested to 80% minimum yield strength up to a maximum of 10,000 psi.

National (B) Buttress Thread—Developed to satisfy the need for a casing joint which will safely and economically support the weight of deep-well casing. The buttress-thread joint is comparable in strength to that of the body of the pipe.

For further information, write to National Tube Division, United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pa. Export Distributors: United States Steel Export Company, New York.

"The world's largest and most experienced manufacturer of tubular products . . ."

USS **National Tube Division of United States Steel**

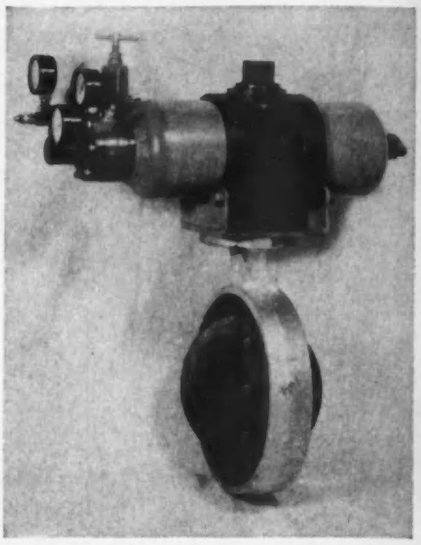


Production-Rate Recorder

A new production-rate recorder, made by Odex Engineering, keeps a complete record of flow rates and pump-off conditions, enabling the operator to isolate cases of erratic production.

A metal stylus, operated by pneumatic impulse, marks the time each barrel is produced. Clock-driven wax charts require no linking. Re-set counter keeps a cumulative total of production. Works are enclosed in a dust-tight case for maintenance-free operation.

For more data, circle **No. E17** on Readers' Service Card, last page this issue.



Positioning Valve Actuator

A new line of positioning valve actuators has been introduced by the Bettis Corporation for conversion of 3 to 15 psi instrument air into high torque operation for throttling or positioning plug valves, ball valves and butterfly valves and other 90 degree rotation devices.

The actuators can develop torque capacities up to 4,500 inch pounds on 100 psi supply air to operate most standard wrench operated valves.

The Robotarm position actuator is a fully enclosed cylinder type pneumatic operator with integral rotating drive mechanism totally sealed in an oil bath.

(This item supplements Bettis Corp. data on Page 693 of the Composite Catalog, 22nd Edition.)

For more data, circle **No. E18** on Readers' Service Card, last page this issue.

WHEELING

COUPLINGS

FOR OIL COUNTRY USE

LINE PIPE COUPLINGS A. P. I.
⅛" to 12"—Seamless, Black or Galvanized
PLAIN TUBING COUPLINGS A. P. I.
1" to 4"—Seamless
EXTERNAL UPSET TUBING COUPLINGS A. P. I.
¾" to 3½"—Seamless
CASING COUPLINGS A. P. I.
4½" to 13⅜"—Long or Short
HYDRAULIC COUPLINGS
⅛" to 4"—Seamless
REAMED AND DRIFTED A. I. S. I.
¾" to 12"—Seamless
DRIVE PIPE COUPLINGS
6" to 12"—Seamless
PIPE NIPPLES
All Sizes and Types
STEEL BUSHINGS AND PLUGS
3,000 lb.

WHEELING MACHINE PRODUCTS COMPANY

WHEELING, WEST VIRGINIA

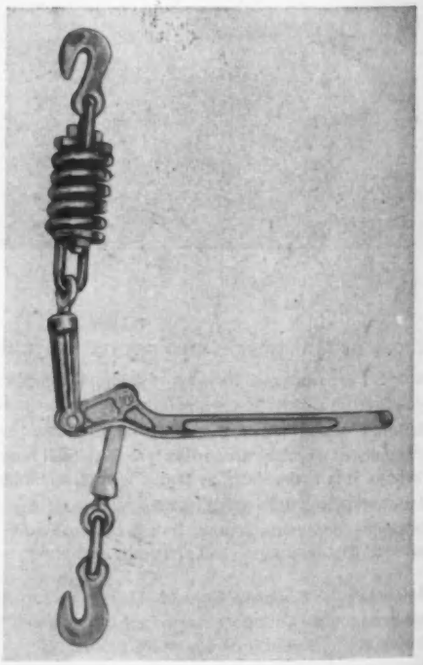
WEST COAST FACTORY: WOODLAKE, CALIFORNIA

X

SALES OFFICES IN LEADING CITIES

Baltimore, Md.—Frank Butler, 2301 No. Charles St.
Chicago, Ill.—Harry A. Jay, Suite 1090, Old Colony Bldg.
Denver, Colo.—W. G. Cline & Co., 4500 Kalamath
Detroit, Mich.—R. W. Lang, Jr., 505 Park Avenue
Erie, Pa.—R. J. Maggi, Box 711
Falmouth, Mass.—Walter S. Bennett, 5 Belvidere Road
Grand Rapids, Mich.—R. W. Lang, Jr., 138 Burton SE
Houston, Tex.—Henry H. Paris Distributor, Inc., Box 932
Independence, Mo.—Craig A. Fross, 3701 Norwood
Long Island City, N. Y.—Max Rothenberg Co., Inc., 11-05 38th Ave.
Los Angeles, Cal.—James A. Riordan Co., 1400 Santa Fe Ave.
Louisville, Ky.—Sid Schultze Co., 849 So. 6th St.
Narberth, Pa.—Worthington-Grothaus Associates, 105 Forrest Ave.
Omaha, Nebr.—Wm. Freiden, Central States Engineering & Sales Co., 5101 Blondo St.
Oswego, N. Y.—Northeastern Associates, Neil Chatterton, Sec'y, P. O. Box 284
Portland, Ore.—J. G. Beard Co., 1233 NW 12th Ave.
Richmond, Va.—P. C. Abbott & Co., 15 E. Franklin St.
St. Louis, Mo.—Walter C. Dollinger Co., 4869 Goodfellow Ave.
Salt Lake City, Utah—Lovell Company, 29 E. 2nd St. South
Seattle, Wash.—Ashe & Jones, 819 Thomas St.
Wauwatosa, Wisc.—W. G. Nelson, P. O. Box 203

QUALITY-CONTROLLED PIPE COUPLINGS SINCE 1918



Snubbing Load Binder

A large coil spring shock absorber built into the new Lebus snubbing load binder

For economical pumping choose from these Bethlehem rods

These four types of Bethlehem sucker rods will handle a wide range of pumping conditions. Each rod is carefully made and thoroughly inspected, and can be counted on to keep strings in the hole for long periods of time. If you have any question about the use of these rods, or about Bethlehem's full line of sucker rod accessories, get in touch with your Bethlehem sucker-rod distributor. Or, if you prefer, the nearest Bethlehem sales office will gladly give you full details.

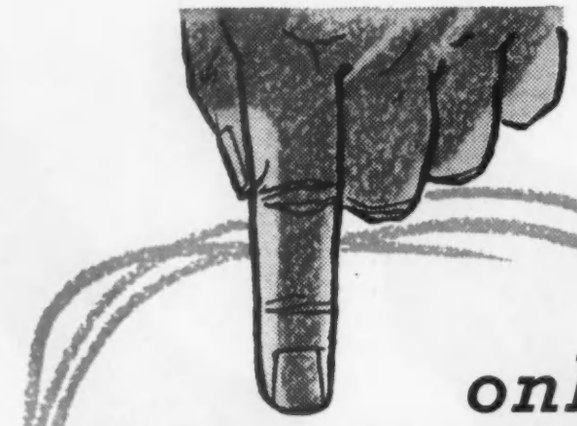
ROD	TYPE	HEAT TREATMENT	YIELD POINT, psi		TENSILE STRENGTH, psi	
			Min.	Av.	Min.	Av.
X 2	Carbon-manganese	Normalized	65,000	72,000	93,000	100,000
X Mayari	Nickel-chromium	Normalized	60,000	65,000	88,000	95,000
46	Nickel-molybdenum	Normalized and tempered	67,000	75,000	82,000	90,000
43	Nickel-chromium-molybdenum	Normalized and tempered	100,000	110,000	120,000	130,000

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

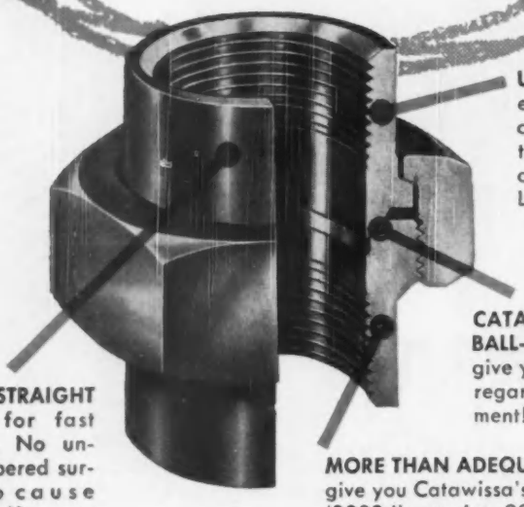
Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL



only
CATAWISSA
gives you all these features for your forged steel pipe union requirements



UNIFORM WALLS for even expansion and contraction under temperature changes. THEY FOLLOW THE PIPE!

CATAWISSA BALL-TO-ANGLE SEATS give you a "Perfect Seal" regardless of pipe alignment!

ROUND, STRAIGHT BARRELS for fast wrenching. No uneven or tapered surfaces to cause wrench slips or wrench locking!

MORE THAN ADEQUATE wall thicknesses give you Catawissa's 3-to-1 Safety Factor (3000-lb. service, 9000-lb. test; 6000-lb. service, 18000-lb. test)!

Catawissa Perfect Seal Pipe Unions are made by Union Specialists from 80,000-lb. tensile strength steel (ASTM Spec. A-105-55T, Grade II). Steel forgings from our own forging mill are closely checked for imperfections . . . and finishing on modern, automatic machines with close inspection during and after production give you pipe unions second to none!

Get your free copy of Catalog 56 showing the complete Catawissa line . . . write direct or stop at your favorite supply store.

CATAWISSA VALVE & FITTINGS COMPANY • CATAWISSA, PENNA.

for complete, guaranteed pipe union satisfaction

. . . always specify
CATAWISSA

. . . at your favorite supply store

eliminates the extra link problem encountered with ordinary binders.

The spring takes up slack without excessive tightening and maintains proper tension, even if the load shifts slightly in transit. By maintaining tension, damage to loads such as gas cylinders, large tanks and building stone is prevented.

Other features of the new Lebus binder include flanging of the handle at leverage point to prevent spreading, and a heel which toggles away from the load to permit easy release. Ball and socket swivel joints on both hook assemblies make connections easier and assure a constant straight line pull.

(This item supplements LeBus Manufacturing Co., Division of American Hoist & Derrick Co., data on Pages 2984-2988 of the Composite Catalog, 22nd Edition.)

For more data, circle **No. E19** on Readers' Service Card, last page this issue.

Permanent Magnet

A new precision permanent magnet with a field strength of 1,717.5 gauss ±0.1 percent and maximum field inhomogeneity at gap center of 40 milligauss (23 ppm) over a two-inch maximum dimension region, is now available from Schlumberger Well Surveying Corporation, Ridgefield Instrumentation Division.

Designated Model 104B, this unit, in effect a secondary magnetic standard, can be used for material analysis by nuclear magnetic resonance (NMR) absorption or spin echo techniques; specialized NMR and EPR research; semi-conductor studies using Adiabatic Demagnetization; measurement of Hall Effect in conductors and semi-conductors; and for education and training in uses and properties of NMR. It is stable in time and temperature.

(This item supplements Schlumberger Well Surveying Corp. data on Pages 4621-4652-L of the Composite Catalog, 22nd Edition.)

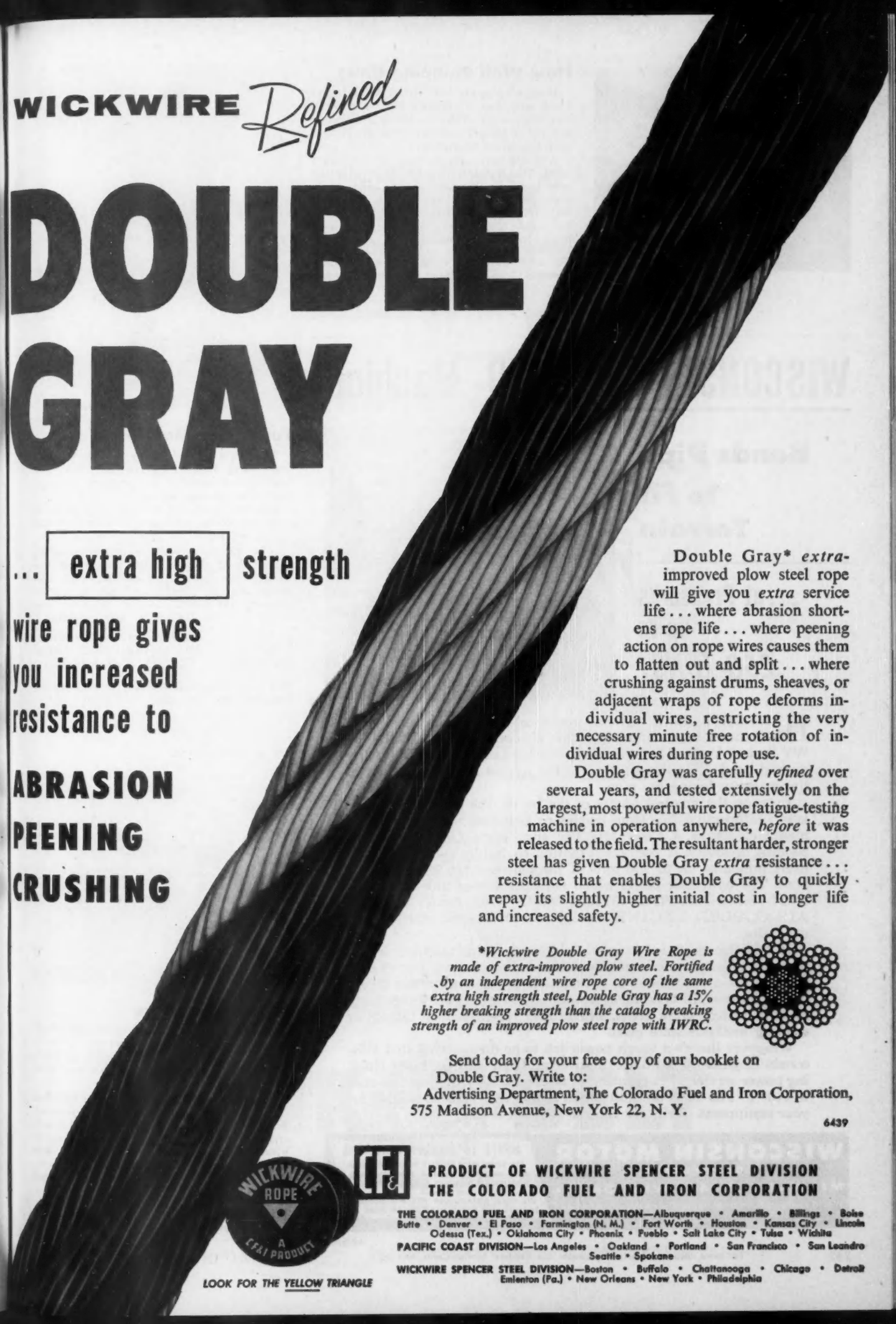
For more data, circle **No. E20** on Readers' Service Card, last page this issue.

WICKWIRE *Refined*

DOUBLE GRAY

... extra high strength wire rope gives you increased resistance to

ABRASION
PEENING
CRUSHING



Double Gray* *extra*-improved plow steel rope will give you *extra* service life . . . where abrasion shortens rope life . . . where peening action on rope wires causes them to flatten out and split . . . where crushing against drums, sheaves, or adjacent wraps of rope deforms individual wires, restricting the very necessary minute free rotation of individual wires during rope use.

Double Gray was carefully *refined* over several years, and tested extensively on the largest, most powerful wire rope fatigue-testing machine in operation anywhere, *before* it was released to the field. The resultant harder, stronger steel has given Double Gray *extra* resistance . . . resistance that enables Double Gray to quickly repay its slightly higher initial cost in longer life and increased safety.

**Wickwire Double Gray Wire Rope is made of extra-improved plow steel. Fortified by an independent wire rope core of the same extra high strength steel, Double Gray has a 15% higher breaking strength than the catalog breaking strength of an improved plow steel rope with IWRC.*

Send today for your free copy of our booklet on Double Gray. Write to:
Advertising Department, The Colorado Fuel and Iron Corporation,
575 Madison Avenue, New York 22, N. Y.

6439

WICKWIRE ROPE — A CF&I PRODUCT

LOOK FOR THE YELLOW TRIANGLE

CF&I

PRODUCT OF WICKWIRE SPENCER STEEL DIVISION
THE COLORADO FUEL AND IRON CORPORATION

THE COLORADO FUEL AND IRON CORPORATION—Albuquerque • Amarillo • Billings • Boise Butte • Denver • El Paso • Farmington (N. M.) • Fort Worth • Houston • Kansas City • Lincoln Odessa (Tex.) • Oklahoma City • Phoenix • Pueblo • Salt Lake City • Tulsa • Wichita

PACIFIC COAST DIVISION—Los Angeles • Oakland • Portland • San Francisco • San Leandro Seattle • Spokane

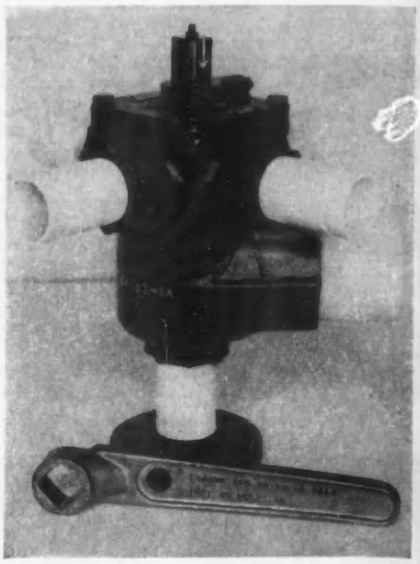
WICKWIRE SPENCER STEEL DIVISION—Boston • Buffalo • Chattanooga • Chicago • Detroit Emlenton (Pa.) • New Orleans • New York • Philadelphia

New Well Pumping Units

Hamer Pumping unit Model A-DR5, pictured with Sam P. Hamer, for water wells and shallow oil wells, the latest addition to the line of Hamer pumping units by Hamer Manufacturing Company.

A small unit with features of the larger units, Model A-DR5 has a double reduction gear box with Timken tapered roller bearings, and wrist pins have tapered self-aligning roller bearings. Bronze bushings are in the saddle and Pitman bearings. This unit has a stroke from 6 inches to 9 inches.

For more data, circle **No. E21** on Readers' Service Card, last page this issue.



Four-Way Manifold Valve

Here is a new economy four-way manifold valve from Enardo Mfg. Co. for water-flood projects or primary production. This multi-port valve is designed to enable the producer to hook up four wells into one valve; with one well on test and the other three on production.

The valve had one 4-inch comingling outlet, four 2-inch inlet ports and one 2-inch test port. Any of the four inlet ports can be placed on test simply by rotating the handle to that position. The valve can be locked in any position.

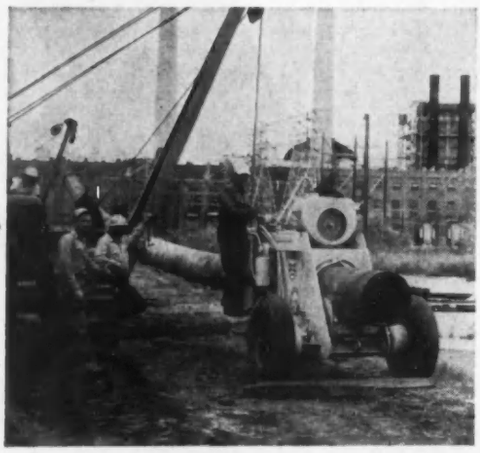
(This item supplements Enardo Manufacturing Co. data on Pages 1691-1694 of the Composite Catalog, 22nd Edition.)

For more data, circle **No. E22** on Readers' Service Card, last page this issue.

WISCONSIN-POWERED Machine

Bends Pipe to Fit Terrain

...at Pressures Up to *250 TONS!*



HANDLING pipe of any size from 6-in. to 20-in. dia., and up to 1½-in. thick in the largest size, this Wisconsin-powered "CINCH WV Series" Vertical Pipe Bending Machine makes practically any desired bend . . . tailor-made to fit the terrain and the contour of the space for laying the pipe.

Even on the greatest angles of the bends, the pipe thickness is kept uniform and free from ripples or wrinkles, according to the manufacturer, M. J. Crose Mfg. Co., Inc., Tulsa, Okla. The actual bending operation is performed by four hydraulic cylinders which exert pressures up to 250 tons at the places where pipe is to be bent. The hydraulic pump which activates the cylinders, is powered by a MODEL VG4D (37 hp.) WISCONSIN HEAVY-DUTY AIR-COOLED ENGINE, equipped with electric starting and generator.

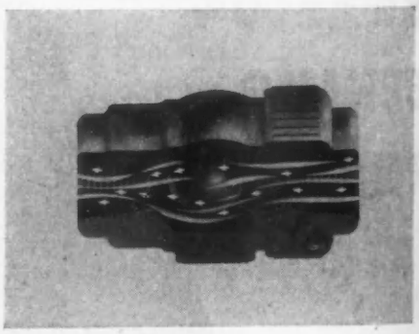
In addition to its value in oil field service, this machine is said to be an ideal piece of equipment for medium or small-sized contractors, as a permanent investment. It is not uncommon to see one of these small bending machines operating on busy thoroughfares in metropolitan areas, where until recently only fittings or welding methods were used.

Wherever there's a tough power job to be done, you'll find Wisconsin Engines (3 to 56 hp.) delivering High Torque, Load-Holding power service . . . operating at temperatures from low sub-zero to 140° F. *You* can't do better than to specify "WISCONSIN" for *your* equipment. Write for Engine Bulletin S-223.

WISCONSIN MOTOR Corporation
MILWAUKEE 46, WISCONSIN
World's Largest Builders of Heavy-Duty Air-Cooled Engines

WRITE TO HARLEY SALES CO.
619 SOUTH MAIN STREET • TULSA, OKLAHOMA
3420 McKINNEY AVENUE • HOUSTON, TEXAS
505 SOUTH MAIN STREET • WICHITA, KANSAS
OIL FIELD DISTRIBUTORS FOR WISCONSIN ENGINES AND ALL TYPES OF UTILITY UNITS

A8-6207



All Plastic Valve

The chem-check valve is the latest development of the Chemtrol Company. This all plastic check valve is available in PVC types I and II, Kralastic, Penton and Profax.

The new valves features include: full-flow —low pressure drop; built-in vibration damper; operated in any position; all standard connectors—thread, socket, flanged, Victaulic grooved and replaceable "seat seal." It is available in pipe sizes from ½ inch to 2 inches and is easily installed and serviced.

For more data, circle **No. E23** on Readers' Service Card, last page this issue.

IT FIGURES:

On the world's deepest well it's LINK-BELT

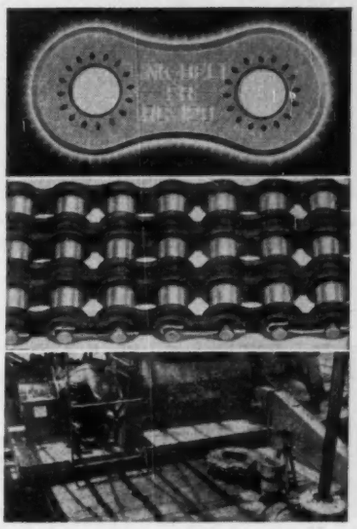
FR*

ROLLER CHAIN

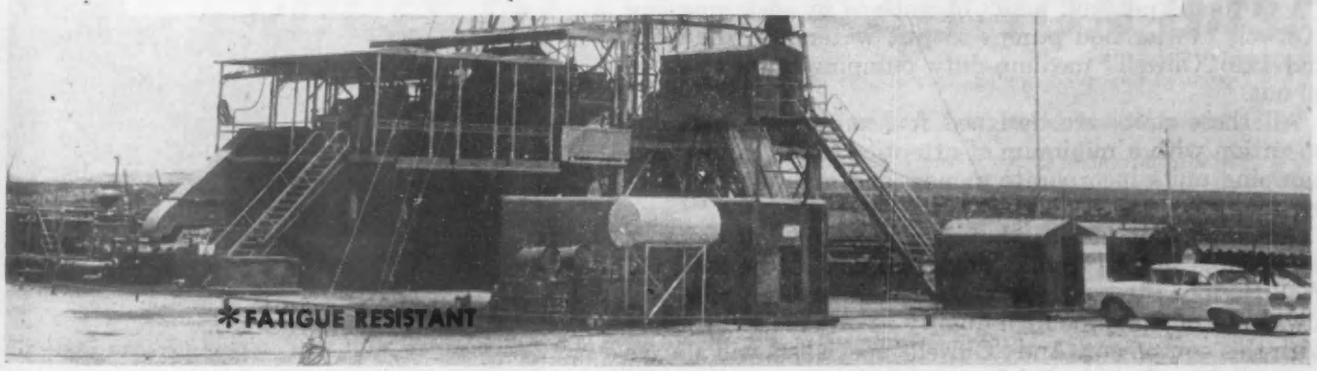
WHEN a National 130 rig pushes past 25,000 feet, it's a cinch no ordinary chain drives can withstand the brutal punishment encountered. No surprise then that this record smashing Phillips Petroleum Rig #27 uses Link-Belt Fatigue Resistant Roller Chain throughout. Twelve-hour round trips . . . hard formations that slowed down drilling to two feet an hour — this chain licked every challenge.

FR is Link-Belt's patented (U.S. No. 2,517,497) process for compressing the metal around roller chain pitch holes . . . the critical areas most vulnerable to fatigue failure. The result: a tremendous increase in *dynamic strength*. And the sort of performance demonstrated at this Phillips Petroleum Co. well.

Catalog 2880 has more facts on FR and all Link-Belt oil field equipment. You can get a copy at any leading supply store.



DRAWWORKS on Phillips' record University "EE" Well No. 1 uses multiple-width Link-Belt Roller Chain (center) with FR-processed sidebars (top).



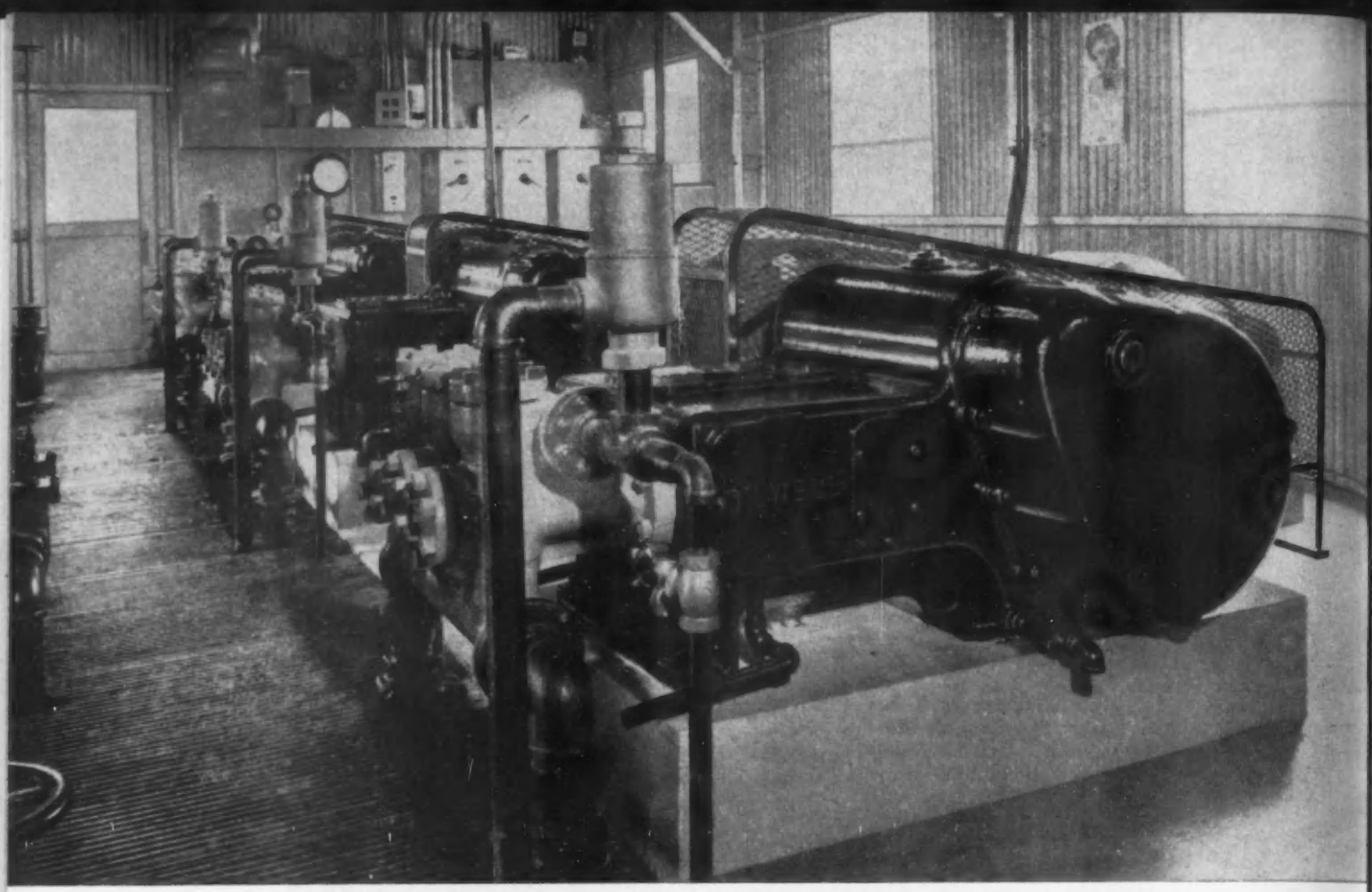
*FATIGUE RESISTANT

LINK-BELT

ROLLER CHAINS AND SPROCKETS

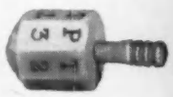
LINK-BELT COMPANY: Indianapolis 6, Houston 1, Dallas 26, Odessa, Tex., New Orleans 16, Shreveport, La., Los Angeles 22 (Montebello), Scarboro (Toronto 13); Export Office, New York 7. Distributors in All Fields.

14,000



Five "Oilwell" 36-P Triplex Plunger Pumps operate this Lee County, Kentucky, waterflood. A first plant with two pumps was installed some two years ago. The second plant with three pumps (illustrated) was added the following year.

Take the risk out of "put and take" with "Oilwell" Pumps and Pumping Units



AN OIL producer in Kentucky has taken the chance out of these "put and take" operations by installing five "Oilwell" waterflood pumps to **put** water into the wells and 125 "Oilwell" medium-duty pumping units to **take** oil out.

All these units are designed for continuous, rigorous operation with a minimum of attention. Both pumps and pumping units incorporate money- and maintenance-saving features.

An important benefit that this operator will enjoy is dependable service from a single source . . . the local Oil Well Supply Store. Maintenance parts and supplies will always be of the same high quality as originally furnished with this equipment. And "Oilwell" specialists will always be available when needed for consultation on any production problems which may arise.

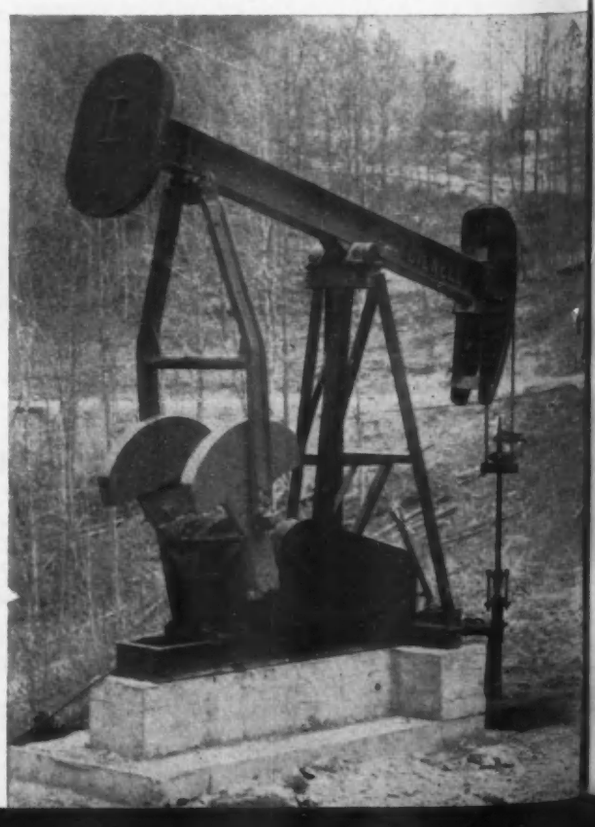
USS and "Oilwell" are registered trademarks

Oil Well Supply Division of United States Steel

USS

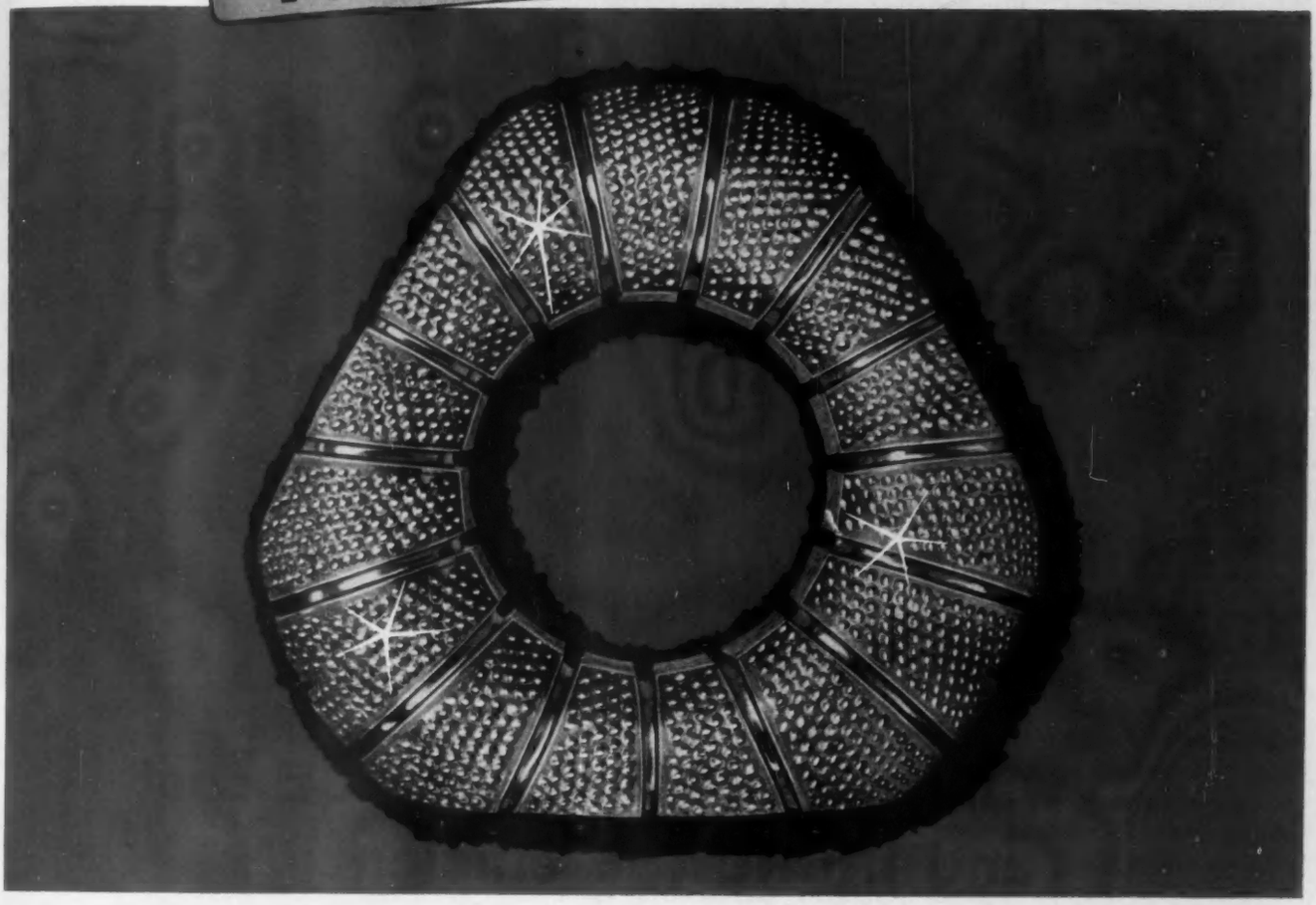
Branches Serving All Oil Fields · Executive Offices—Dallas, Texas · Area Offices—Calgary, Alberta · Casper, Wyoming · Columbus, Ohio · Dallas, Texas · Houston, Texas · Tulsa, Okla. · Los Angeles, Calif. · Export Office—30 Rockefeller Plaza, New York 20, N. Y.

This installation is typical of the electric-powered "Oilwell" 25L3 Pumping Units which are used to take out the oil.



NOW!

PROVED WORLD-WIDE . . .



D & S TRUCO Tri-Dia JET ACTION Bits!

In every major oil area, through all formations D&S Tri-Dia Jet Bits have set unequaled highs in drilling for less. In all cases faster penetration rates and longer bit life have resulted in substantial over-all rig savings. D&S Truco Bits are not "on the shelf" items. Each bit is carefully engineered to fit . . . (1) volume circulated, (2) type mud, (3) formation, etc. Only careful planning regarding your drilling program can give you the same amazing results that drillers have had in these areas . . . Mid-Continent area, Rocky Mountain area, Permian Basin, Gulf Coast area, Canada, the Middle East, Venezuela, and Brazil.

WRITE TODAY! One of our sales engineers will call on you and explain this revolutionary Tri-Dia Diamond Bit.

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OFFICES IN ALL PRINCIPAL OIL AREAS

Ultra Fine Diamond Equipment for the Oilfield

. . . with features that REDUCE cost and INCREASE efficiency!

Field Performance has proven that pistons of this new design not only give more piston-rubber service life, but also produce higher pump and piston efficiencies . . . resulting in unbelievable savings over conventional pistons.

This design requires only *three* body sizes for the full line of rubbers (5″ through 8″) . . . with *four* sizes of rubbers for each body (4-on-1) . . . and the body will *never wear out.*

Each time you install new rubbers, you renew the close original clearance between the piston rubber's metal support and the liner. This feature greatly reduces rubber pinch-off, which causes most piston failures.

But don't take our word for it! Try them in your own pumps, regardless of make, where you can gain firsthand knowledge of their performance and cost saving features.

Wilson-Snyder Works, Oil Well Supply Division of United States Steel, Braddock, Pa.

USS and Wilson-Snyder are registered trademarks

ASK for them at your oilfield supply store.

Wilson-Snyder Works
Oil Well Supply Division
USS United States Steel

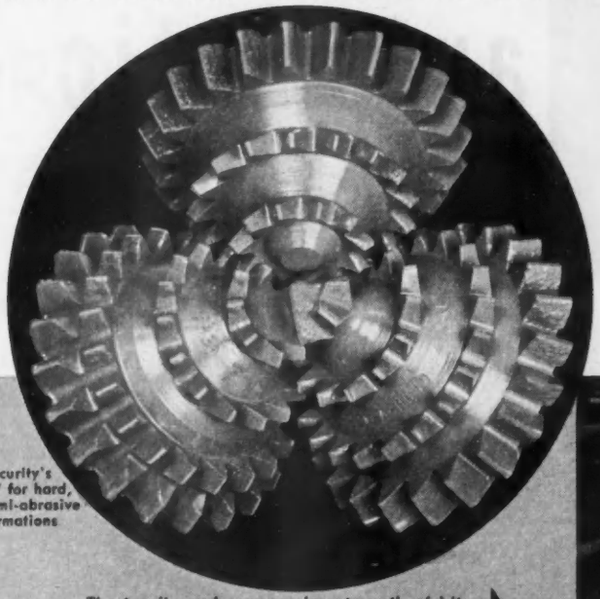
ANOTHER REASON WHY SECURITY BITS PACE THE INDUSTRY:

Security Gives You

QUALITY-TESTED BITS

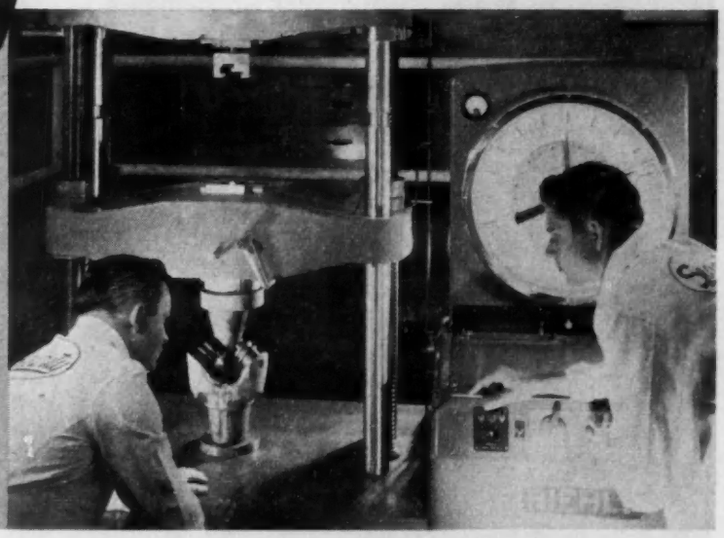
— checked by a minimum of

276 INSPECTIONS PER BIT!

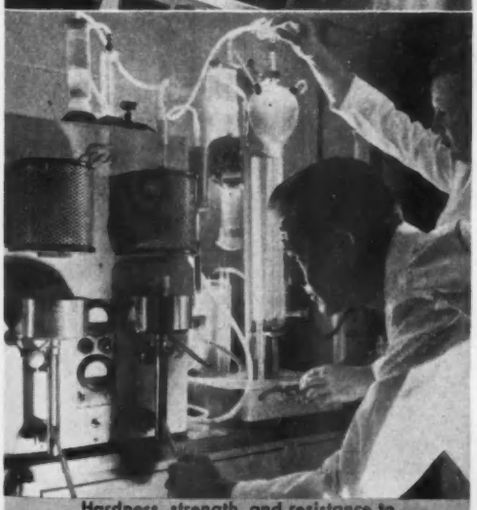


Security's H7 for hard, semi-abrasive formations

The tensile and compression strength of bit components and bit assemblies are tested by use of Universal load-test equipment capable of producing weight loads of 60 tons.



The crystalline alignment of steel, here being determined by X-ray diffraction, affects the ultimate performance where strength, fatigue, impact, and hardness are important factors.



Hardness, strength, and resistance to abrasion are related to carbon content. Security controls carbon content in both raw materials and finished parts by frequent checks using induction volumetric analytical equipment.

AVAILABLE THROUGH YOUR FAVORITE ACCREDITED SUPPLY STORE

Deeper and faster drilling plus new and more effective drilling methods have created rugged demands on rock bit construction. Security rock bits are designed and manufactured to meet present-day drilling requirements.

Security's exceptionally rigid inspection procedures insure that design and manufacturing specifications are met. Beginning with careful testing of mill samples of steel and continuing through all manufacturing operations, a minimum of 276 inspections is required to insure Security's high quality bit construction.

These inspection procedures include: chemical and spectrographic analyses . . . carbon determination . . . tensile and compression testing . . . magnaflux . . . metallographic examination . . . surface, dimensional, and environmental testing.

Special inspection methods developed by Security—and used exclusively by Security—further assure the *dependable* high quality of Security rock bits. Every Security bit is inspected through every stage of its development and construction. This extra care in manufacturing bits assures you of Security's greater down-hole dependability.

Write for further information about Security QUALITY-TESTED rock bits.

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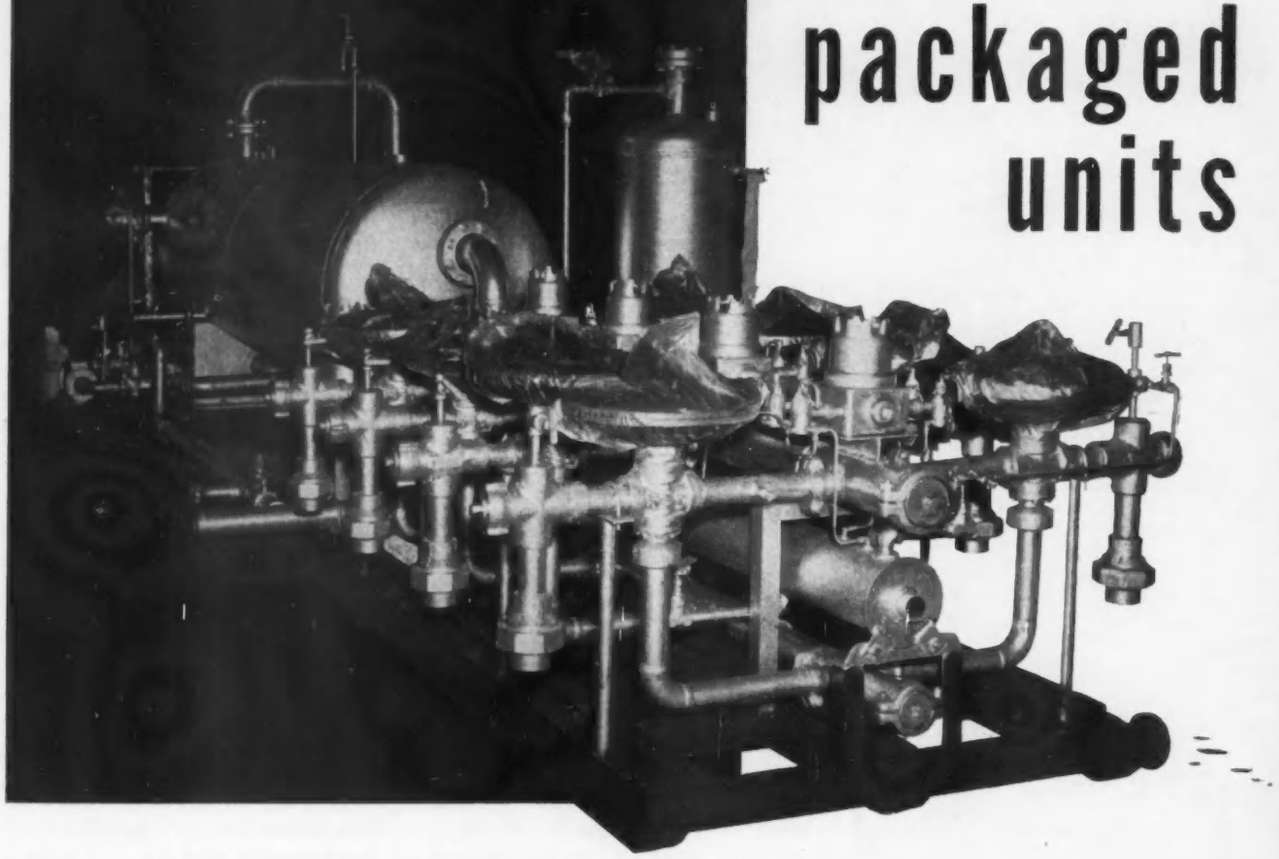
For more data on advertised products, use Readers' Service Cards, last page.

NATIONAL® automatic packaged units

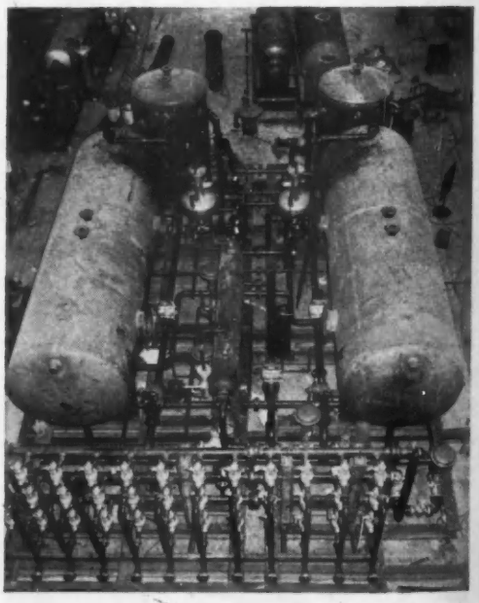


WHY BUY NATIONAL PACKAGED PRODUCTION EQUIPMENT UNITS . . .

- **Made in shops having the most complete and modern facilities available**
- **Safe-tested under strictest codes**
- **Properly engineered for accessibility**
- **Lower cost due to National know-how**

National Packaged Units assure delivery at the location of COMPLETE units . . . skidding, piping, insulation, instrumentation, coatings and accessories. "Packaging" by National eliminates the purchase and assembly of hundreds of items; eliminates costly waiting time and transportation charges rounding up missing materials and fittings.

Through good engineering, design and arrangement, the connection crew in the field is concerned only with the major product lines to and from NATIONAL PACKAGED UNITS.



National can handle all your production problems "from the wellhead to the consumer."

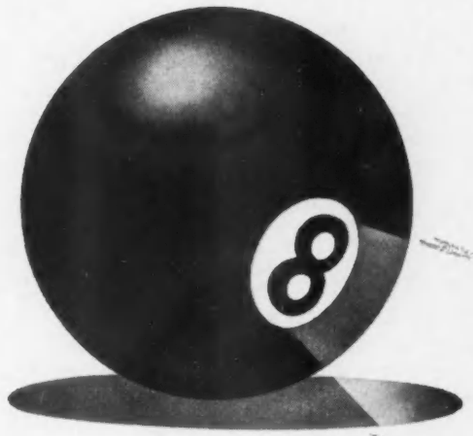
It's a National®

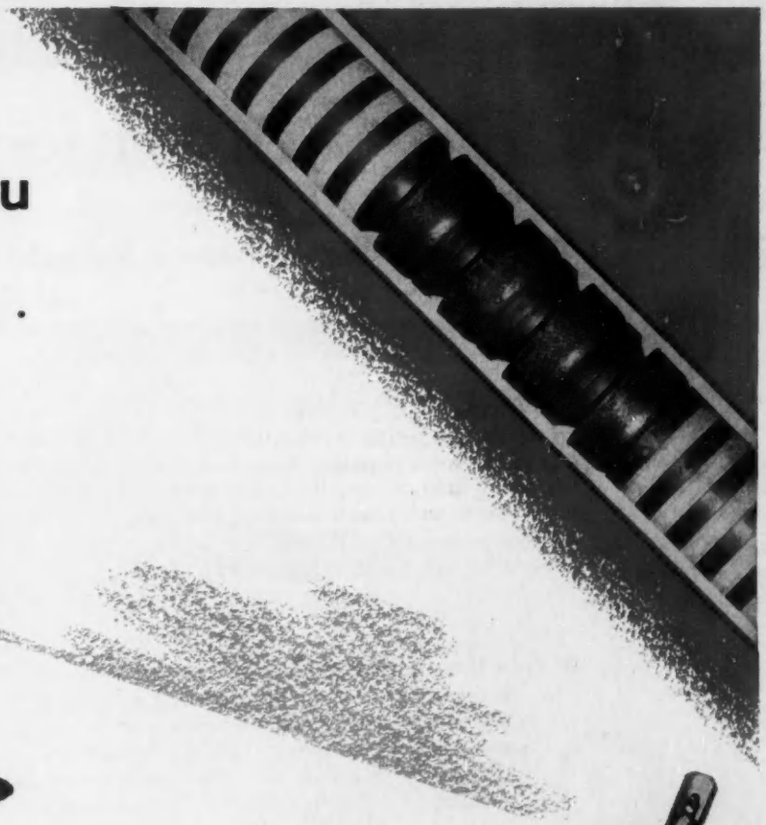
Modern facilities include sand blasting and coating.

NATIONAL TANK COMPANY

TULSA, OKLAHOMA

PRODUCTION COSTS can get you behind the 8-ball . . .



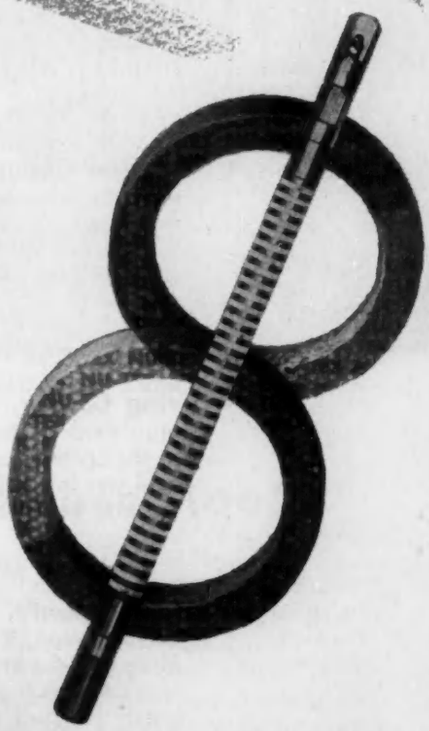


Put the dollar sign of savings on that 8-ball

ECONOMIZE with NU-TEX bottom hole ring pumps

- Low First Cost
- Low Maintenance
- Production Workhorse of the Industry

AVAILABLE AT ALL SUPPLY STORES



BMW

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BRADFORD MOTOR WORKS
General Office and Factory, Bradford, Pennsylvania
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Good Wells Make Good News

A Monthly Report of Successful Well Treatments

December 1, 1958

Of all the fracturing services offered by Dowell, there are several reasons why Sandfrac® is one of the most popular. Net cost is low because the lease crude or refined oil used as the fracturing fluid can usually be sold with well production. Reliability is high because emulsion, water block and silicate swelling problems are kept to a minimum. Most important, results have been generally excellent and payouts have been fast. Here are four recent jobs that illustrate types of wells especially suited to Sandfrac.

- **Ochiltree County, Texas Panhandle.** (New Oil Well) This well was completed in the upper Morrow sand of the Farnsworth pool through perforations from 7930 to 7940 feet. Dowell recommended Sandfrac using lease crude on the basis of tests run on formation samples and on the field crude. The treatment was designed to give the operator good results with freedom from emulsions and clean-up troubles. 95 barrels of lease oil carrying 6000 pounds sand were pumped down casing and into the pay at 19 bpm. *After clean-up, well produced 39 boph on Railroad Commission Test.*

- **San Juan County, New Mexico.** (New Gas Well) This well was completed through perforations from 6236 to 6248 feet into the Gallup sand. Initial production was a non-commercial 5 mcfd. Operator ordered Sandfrac. Dowell injected 19,000 gallons lease oil with 19,000 pounds sand and 45 perforation ball sealers. Average injection rate was 47.6 bpm with a maximum treating pressure of 3600 psi. *After treatment, well tested 43,193 mcfd.*

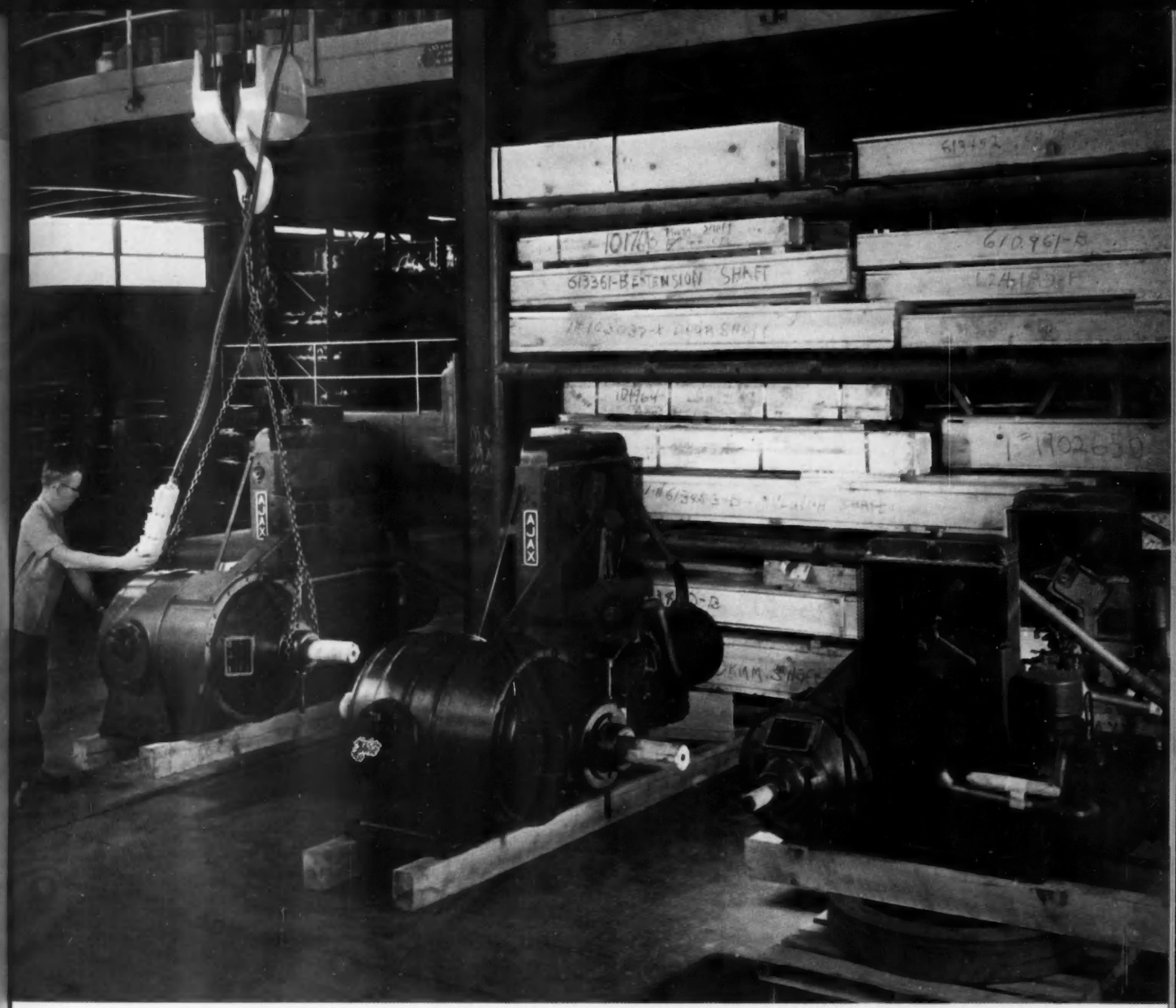
- **Loving County, Texas.** (Old Oil Well) This well was originally completed with nitro shots in the Delaware sand at 4335 feet. Production had declined to 8 bopd, so the operator ordered Sandfrac. 10,000 gallons lease crude carrying 15,000 pounds sand was injected at 30 bpm and 1300 psi. Total cost for Dowell service to operator was only $1670. *After clean-up, well tested 350 bopd.*

- **Garvin County, Oklahoma.** (New Oil Well) This well was completed in the Bromide sand of the East Antioch pool. Perforations were from 5602 to 5678 feet. Since well would not produce without stimulation, operator ordered Sandfrac. Dowell injected 10,000 gallons refined oil with 10,000 pounds sand and 100 pounds of temporary plugging agent. Injection was down 2½-inch tubing at 5200 psi and 8 bpm. 10 gallons Freflo® was used to aid in clean-up. *After treatment, well flowed 240 bopd on test.*

For more detailed information or prompt service, call any of the 165 Dowell offices and service points. In Canada, call Dowell of Canada, Ltd.; in Venezuela, contact United Oilwell Service. Or write Dowell, Tulsa 1, Oklahoma.

Services for the oil industry DOWELL

DIVISION OF THE DOW CHEMICAL COMPANY



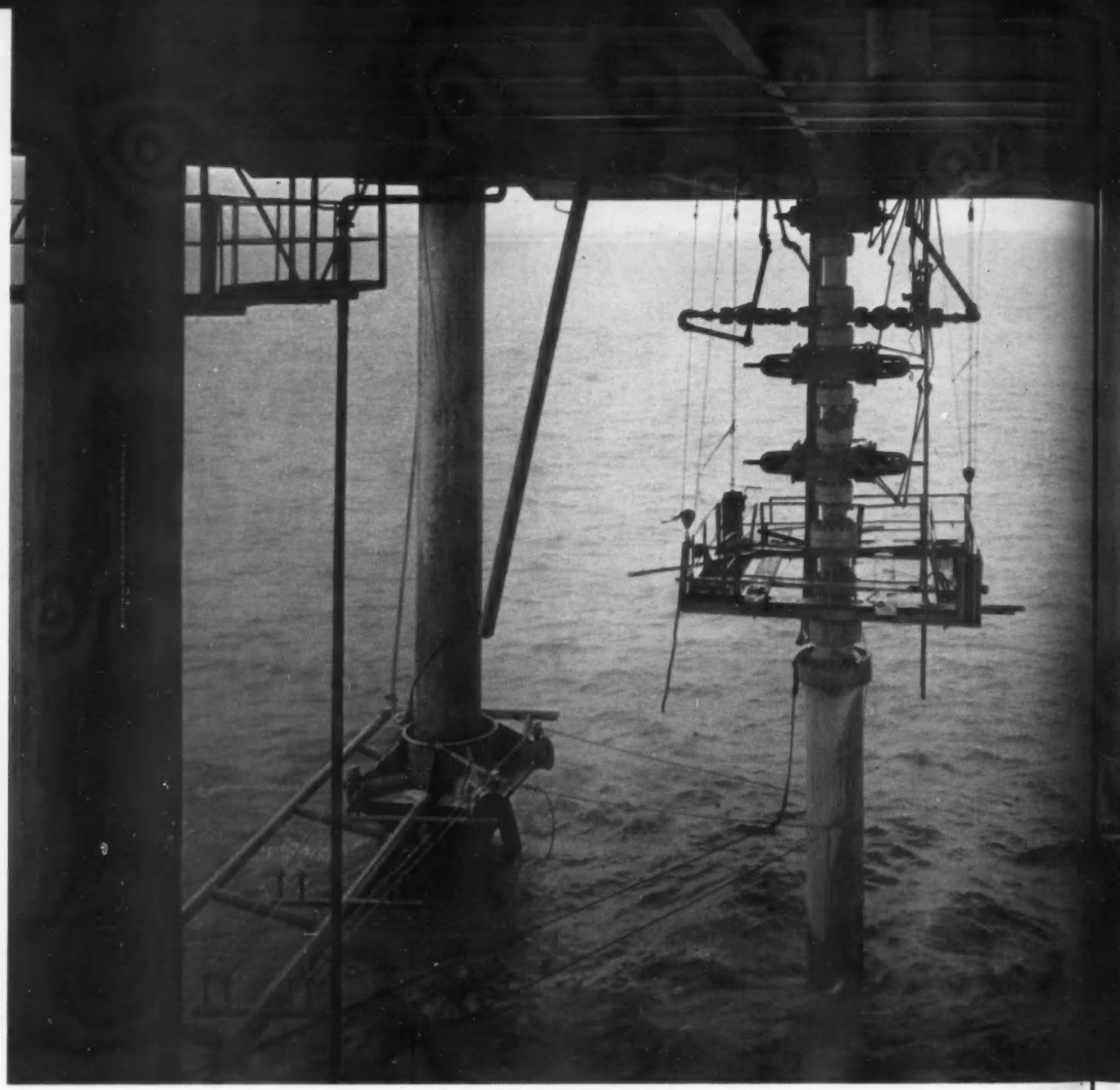
Ajax Engines are typical of the line of quality equipment stocked and distributed through National's 130 stores.

You'll get ideas in our warehouse, too!

The truth of the old saying, "Out of sight, out of mind," often bothers us. We know that every National Supply Store is well-stocked with quality equipment like these Ajax Engines . . . but you'll probably never see much if you do all your shopping at the counter. In fact, what you see from the front counter is such a small part of our ample stocks that we'd often like to remove it!

We won't eliminate this convenience, of course. But we can urge you to walk behind it any time and get better acquainted with the *whole* National Supply Store. You'll see equipment like these Ajax Engines . . . Link-Belt Chain . . . Oilmaster Pumps . . . Tube-Turn fittings . . . Rockwell-Nordstrom Valves. The list of outstanding equipment is a long one, and we're pleased to be associated with every name on it. More important, it's equipment we know you can use to operate profitably.

So shop behind our counter, too —in places like the warehouse, equipment yard and pump shop. It's a tour you owe to yourself, because the "*in* sight, *in* mind" experience can produce some good ideas for improving your own operations. We know. We've seen it happen many times.



This view of a National Wellhead beneath an offshore rig platform shows one of the largest wellhead assemblies ever manufactured.

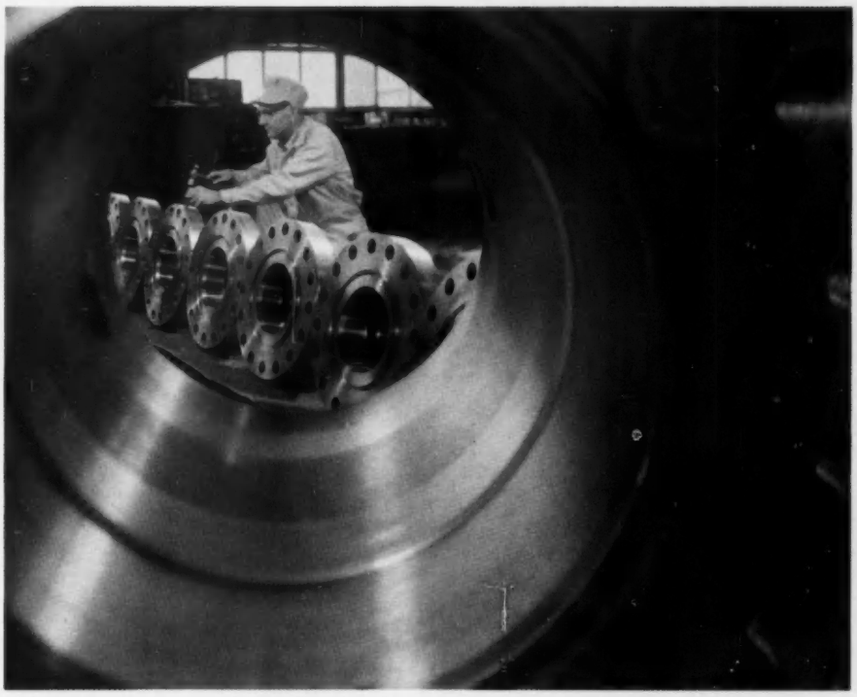
You get these 6 big advantages with National Wellhead Equipment—

1. **Ease of assembly**—The overall simplicity of National Wellhead design makes every unit easy to assemble and maintain. Parts are self-locating and self-activating, and no special tools or adjustments are needed for installation.

2. **Maximum flexibility**—National's precision-engineered units are interchangeable, thus permitting an unlimited number of combinations to meet your specific requirements in size, capacity and type.

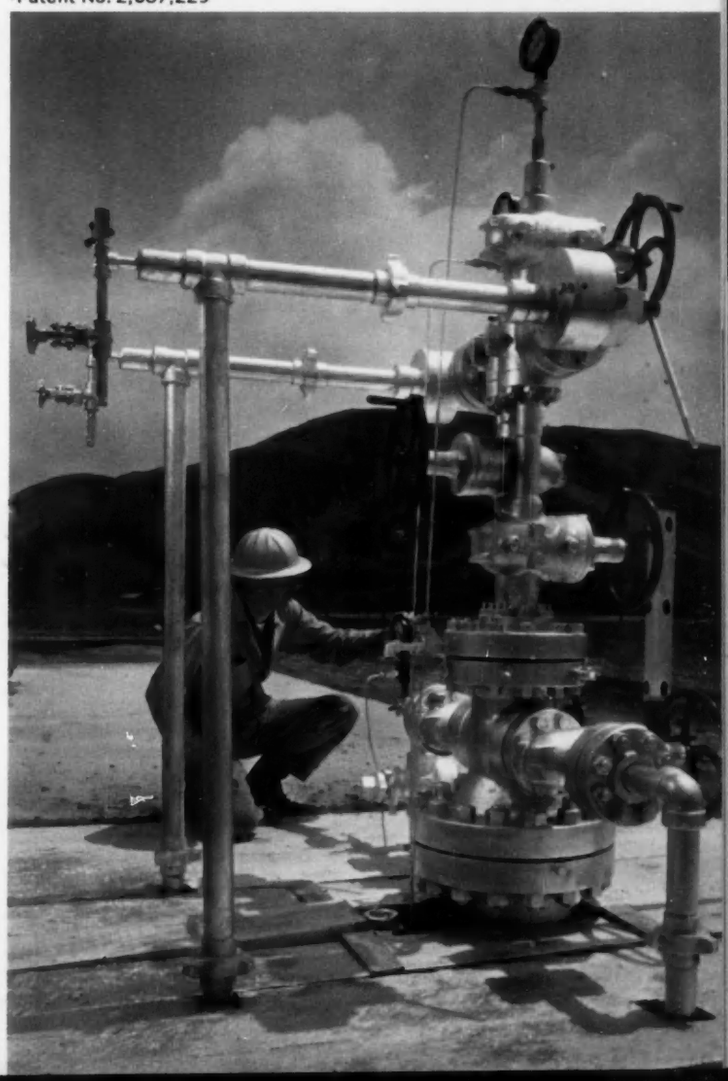
3. **Pre-tested safety**—National's triple-sealed Pressure Pack design insures trouble-free performance and longer service life. Intensive pressure testing procedures are more severe than those specified by API standards.

4. **Multiple completion designs**—There are five types of dual string equipment in National's line—all designed for safe, profitable completions in a full range of working pressures. National triple completion assemblies are also available.



A "flange eye" view in National's Houston plant shows the stamping of serial numbers on units during the production process. The Houston Plant is devoted exclusively to wellhead manufacturing.

This National Supply dual completion assembly is located near Ventura, California. It utilizes the time-proven Laurent* seal to give sealed-in-steel construction for the life of the well.
*Patent No. 2,687,229



5. Readily available stocks—Through National's oilfield supply store network—largest in the world—you can readily obtain this quality wellhead equipment.

6. Experienced advisory service—Complete advisory service on any wellhead application problems is available through any National Store or office. An experienced staff of National Wellhead specialists provides help wherever needed.

With this group of advantages, you can see why it pays to use National Wellhead Equipment and the service that comes with it. Ask the National representative in your area for full details.

More National equipment for profitable production on the next page...

National Triplex Pumps are reliable on a host of oilfield pumping jobs including water-flooding, salt water disposals, and as power-oil sources for subsurface hydraulic pumps.

...and you get low-cost pumping with National Triplex Pumps!

A minimum of pumping downtime means low-cost pumping, and that's what you get with National Triplex units. They have heavy-duty housings and frames, long-life bearings, stainless steel valves, and National's time-proven lubrication systems.

Plungers, fluid ends and cartridge-type stuffing boxes are readily interchangeable to meet varying pressure and volume needs, and are available for either corrosive or non-corrosive service. In every respect, these triplex pumps show the quality construction for which all National Supply equipment is famous.

Ask the National representative in your area for more information on National Triplex Pumps—and any of the other dependable production equipment shown on this page.

Get reliable service from precision-made National Sucker Rods. They have top resistance to fatigue, shock, corrosion and impulse loads. National Sucker Rods are available in a range of grades to meet every well condition.

National Pumping Units are manufactured in 22 standard combinations, plus various long stroke and portable variations. In the range of API rated beam loads from 3,200 to 32,400 lbs., there's a unit to economically meet your needs.

National Plunger Lift can be the best production method for certain types of wells. It uses formation gas or injected gas for operation, has low initial and service costs. Equipment is also available for gas well operation to remove liquids and maintain a uniform and increased flow rate of gas.

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Subsidiary of Armco Steel Corporation

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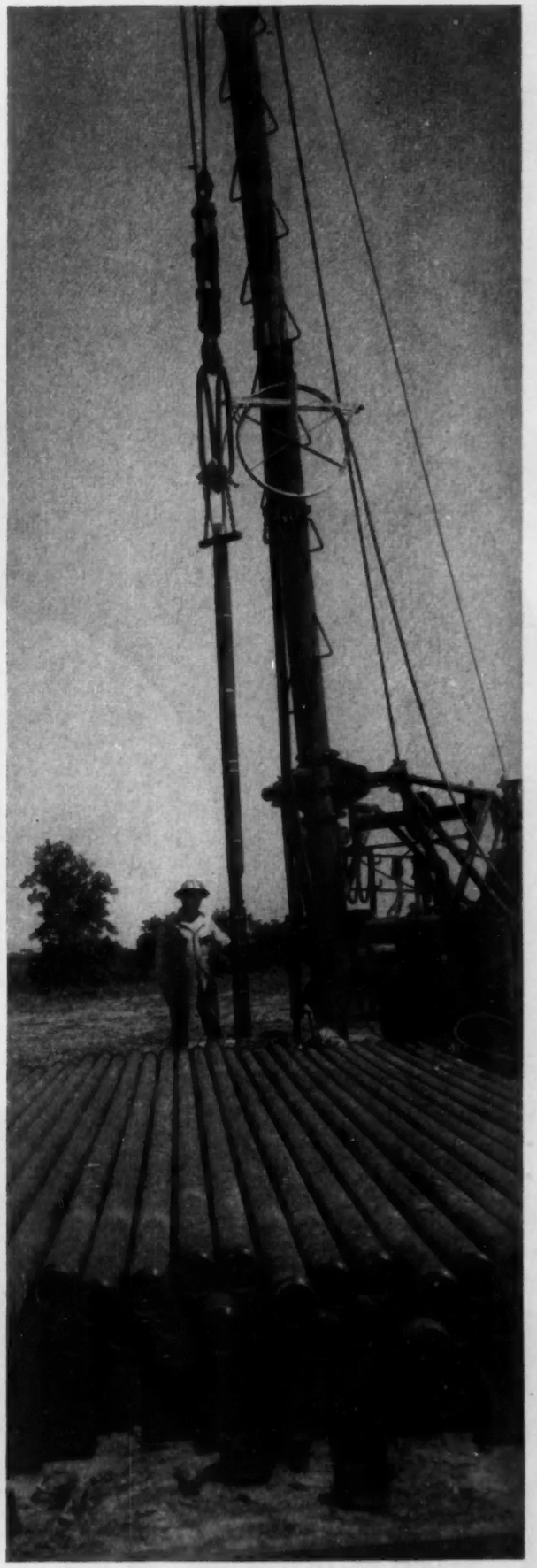


This Submergible Pump handles corrosive salt water for injection. Does its job dependably with "K" Monel alloy pump shaft, Ni-Resist* diffusers, Monel-armored cable. Made by Reda Pump Company, Bartlesville, Oklahoma.

Submergible pump takes long drink of carbonated salt water ...uses "K" Monel shaft

This Reda pump takes a 1400-foot "drink" of carbon dioxide-containing water — economically raises it that distance for injection into a lease in central Oklahoma. The corrosive water doesn't chew up the pump shaft — it's made of "K" Monel* age-hardenable nickel-copper alloy. Turns in extra service, too, because of its extra strength.

The Reda multistage centrifugal pump is widely used to pump oil or water under severe conditions. It pumps sandy wells . . . gassy or paraffin-bearing wells . . . crooked wells. Most of all — corrosive wells.

This pump's "K" Monel alloy shaft and Ni-Resist ductile iron parts make it unusually resistant to corrosion by sulfur-bearing crudes and acidic brines. Together with high capacity and low operating cost, this corrosion-resistance enables the pump to extend greatly economic well life. The cable supplying power to the pump is clad with Monel* nickel-copper alloy tape for extra protection against corrosion and wear.

If you have corrosion problems, you can get tools built with Inco Nickel Alloys at vital points . . . these alloys have excellent strength, too. Check your tool supplier.

See how other producers combat corrosion with Inco Nickel Alloys. Write for "Metals to Make Petroleum Production Equipment Produce More."

*Registered trademark

THE INTERNATIONAL NICKEL CO., INC.
67 Wall Street — New York 5, N. Y.

INCO TRADE MARK

INCO NICKEL ALLOYS

no well is "completed"...

until the vital casing I.D.
has been scraped clean and smooth with a

BAKER
ROTO-VERT CASING SCRAPER

Leaves the important "working surface" of the casing permanently safe for running swabs and testers, and for setting bridge plugs, packers or cement retainers.
★ Can either be rotated or "spudded" to remove hardened rotary mud, the thin sheath of cement left by the bit, and burrs from gun-shot holes. Usually run above the bit to clean the casing while drilling out cement.
★ Available anywhere, anytime; just specify Baker ROTO-VERT Casing Scraper, Product No. 620-C.

BAKER OIL TOOLS, INC. / HOUSTON / LOS ANGELES / NEW YORK

CAPITOL

F.S. Screwed and Socket Weld

Ells & Tees

STRONGER

where needed most — at the threads

HEX BUSHINGS

UNIONS

2000 # and 3000 # — All sizes, ⅛" through 4"

6000 # — all sizes, ⅛" through 2"

Get Capitol EXTRAS

at no additional cost

WIDER BANDS give greater strength where strength is needed—at the threads . . . plus added wrenching surface.

UNIFORM TOP QUALITY equals or exceeds requirements of MSS-Sp-49 and ASTM-A-105, Grades I and II. Thread gauging better than industry standards . . . distinctive protective coating.

CLEAR MARKINGS on each fitting identify CAP brand, size and pressure . . . prevent costly errors. For maximum protection against damage to life and property, specify Capitol Forged Steel Fittings . . . your best assurance of trouble-free installations.

CROSSES

2000 # and 3000 # Screwed Type — All sizes ⅛" through 2"

6000 # Screwed Type — All sizes ⅛" through 1½"

45° ELLS

2000 # and 3000 # Screwed Type — All sizes ⅛" through 2"

6000 # Screwed Type — All sizes ⅛" through 1½"

STREET ELLS

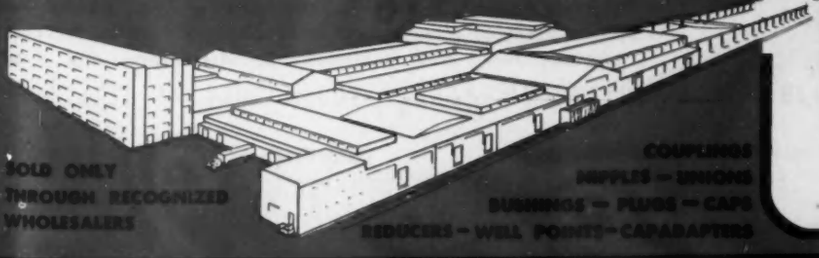
2000 # and 3000 # Screwed Type — All sizes ⅛" through 2"

6000 # Screwed Type — All sizes ⅛" through 1½"

CONVENIENTLY CARTONED

Packaged in small cartons for easier handling . . . easier inventory . . . simplified storage. Labels are color-keyed: Green — 2000 #; Blue — 3000 #; Orange — 6000 #. Avoid mistakes . . . protect against damage . . . save time with CAP fittings in cartons.

ASK YOUR DISTRIBUTOR about these and other quality Capitol fittings.



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MFG. & SUPPLY CO.

COLUMBUS, OHIO

1958

MORE WAYS THAN ONE

TO BE AN OIL MAN

Ask the toolpusher what he is, and he says he's an oil man. Ask the mud dealer, the wire line operator, the supplier. Ask the tool rental man, ask the man 'dozing the slush pits, the drilling contractor, the producer. They are all oil men. And the oil industry depends on all of them and many more.

The Oil and Gas Department of The National Bank of Commerce of Houston has helped and is helping all of these oil men. The Commerce can help you because it knows what it's talking about, and, even more important from your point of view, it knows what *you're* talking about. If you are planning to drill, if you are planning to extend needed services, if you are in the oil business, you'll find that The National Bank of Commerce will help you all the way.

E. O. Buck, *senior vice president*
Oil and Gas Department.

THE NATIONAL BANK OF

COMMERCE

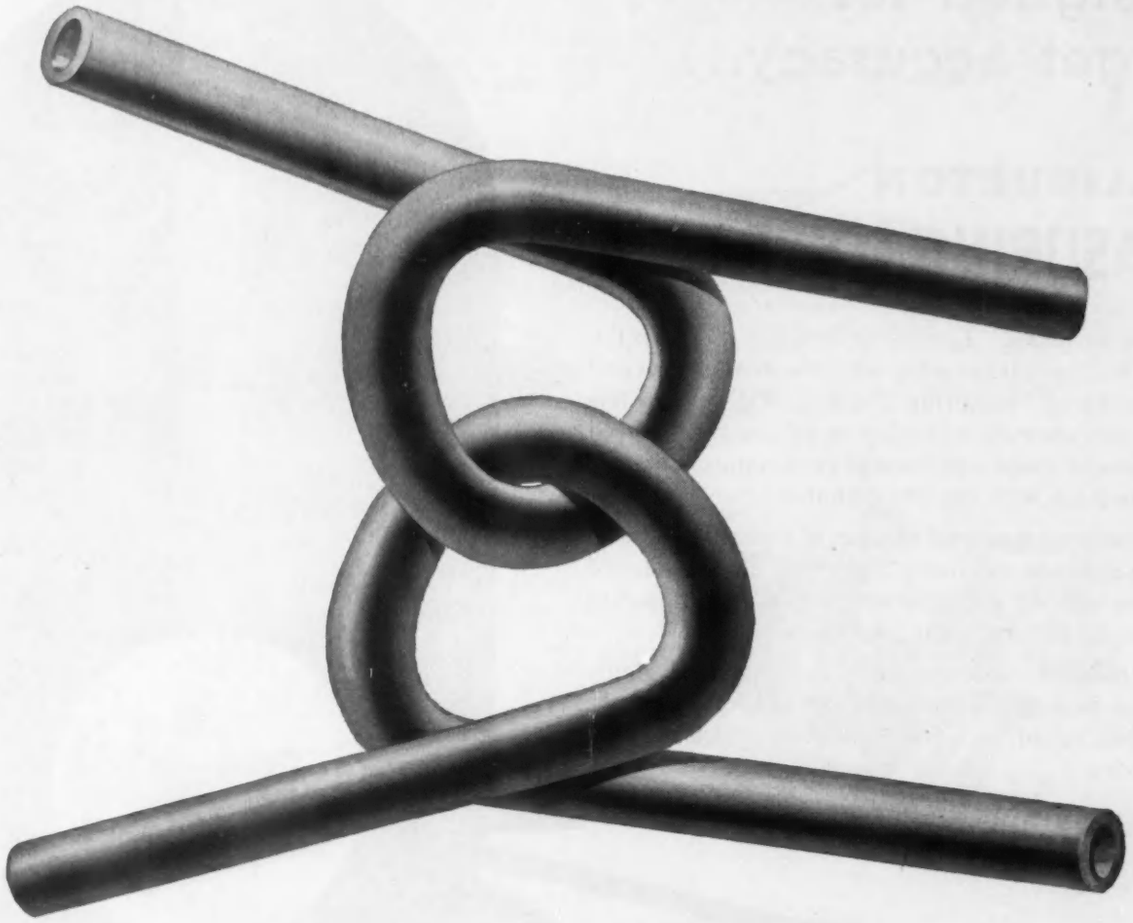
OF HOUSTON

GULF BUILDING MAIN AT RUSK HOUSTON

Facilities of the Oil and Gas Department of The National Bank of Commerce of Houston are available in Wyoming, Nebraska, Colorado, New Mexico, Louisiana, Mississippi, and Texas.

MEMBER
FEDERAL
DEPOSIT
INSURANCE
CORPORATION

PUZZLED by pressure tube problems?



Let Timken Company metallurgists select the one steel analysis that gives you maximum tube life per dollar

A VARIETY of high temperature steels can handle the combination of pressure, temperature and corrosion that your operation creates. But only *one* steel analysis can handle your problem in the most economical way, give you maximum tube life per dollar.

Timken Company metallurgists can find it for you fast. They're recognized experts in high temperature steels because they're backed up by more than 25 years of research and experience. They've solved hundreds of industry's toughest pressure problems—economically. Ask these experts for help and you can be sure of getting the best possible tube life per dollar.

And we've got the steels to do the trick. You can get Timken® seamless pressure tubes in sizes up to 11" O.D. x 3¼" wall—available in all stainless and alloy grades to meet almost any combination of operating conditions. And because we make only electric furnace fine alloy steel, you can be sure of accurate analysis, uniformity from heat to heat, order to order, tube to tube.

Why not save money by letting Timken Company metallurgists solve your pressure problem? The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".

TIMKEN *Fine Alloy* STEEL

TRADE-MARK REG. U.S. PAT. OFF.

SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS STEEL TUBING

designed for target accuracy...

HALLIBURTON
MEASURING EQUIPMENT

First in the field... First in performance... this is the record Halliburton has achieved in the development and pioneering of Measuring Devices. Halliburton has maintained constant leadership in advancing improved Measuring Equipment through continuous research, keeping pace with current demands.

Many different types and varieties of manually operated or power-driven measuring assemblies can be selected for your specific requirements, with the assurance of accuracy, simplicity and effectiveness.

Your local Halliburton Representative will gladly assist in analyzing your needs and help to select the units best suited for your particular operation... call him today.

HALLIBURTON MEASURING EQUIPMENT...

FOR WELL CALCULATED MEASUREMENTS

MEASURING LINES

Halliburton has more years experience with rounded steel measuring lines than all other organizations of its kind. Changing field requirements and modern operations demand even more rigid specifications, permitting only those lines that do the best job to be offered. Your requirements determine which is most suitable...

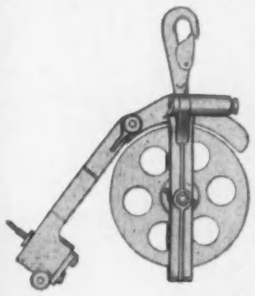
REGULAR LINE

GALVANIZED LINE

* Regular, Bright and Improved Steel—for economical use in wells under normal condition.

* Stainless Steel—designed for longer life when attacked by sour crude oil or gas.

* Galvanized Steel, Zinc Impregnated—will not rust, check or peel under normal operating conditions.

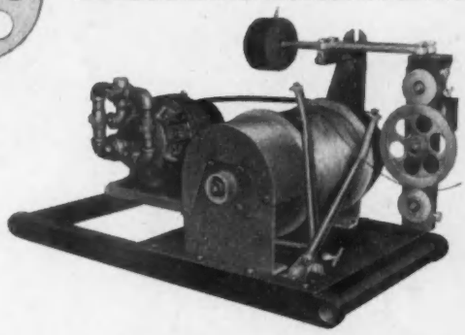


LATCH TYPE HAY PULLEY WITH LINE WIPER

This standard assembly is recommended for paraffin cleaning and may be used to run line in open hole, drill pipe, tubing or casing. The Halliburton Measuring Line Wiper keeps line clean and assures greater accuracy and longer life.

STUFFING BOX AND STAFF ASSEMBLY

Recommended for measuring in open hole or casing while well is shut in under pressure up to 15,000 psi. The wearing surface of measuring line sheave is made of durable, long-wearing material and is precision designed.

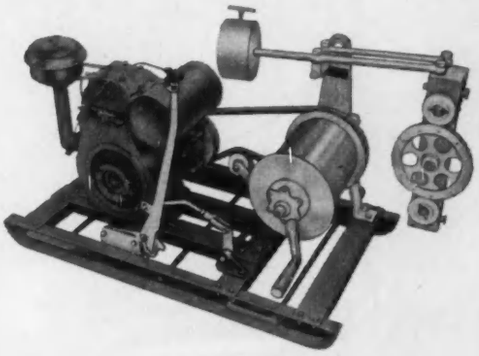


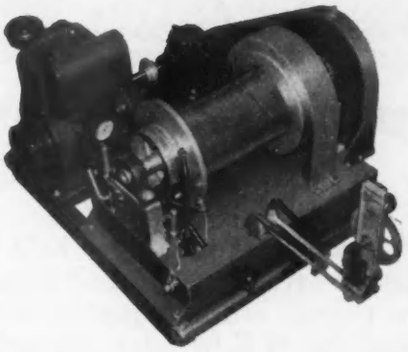
AIR-POWERED MEASURING ASSEMBLY

Driven by compressed air power for greater safety and flexibility. Suited for well measurements requiring high starting torque, accurately controlled variable speed, or where possible safety hazards exist. Powered by radial 5-cylinder air motor, with built-in gear reduction.

REGULAR DUTY TYPE POWER-DRIVEN

Designed for fast, efficient service on light measuring operations. Driven by single cylinder, air-cooled, 4.3 H.P. Briggs and Stratton gasoline engine with gear reduction power take-off. Reel is equipped with V-Belt Drive, V-Belt Idler Pulley Clutch Assembly and will carry 8000′ of .092″ dia. measuring line.





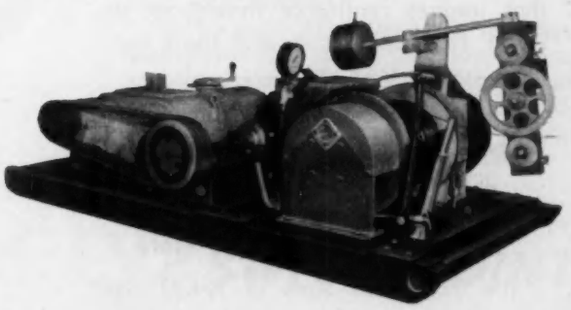
SUPER DUTY TYPE POWER-DRIVEN

Designed for measuring work requiring large amounts of Measuring Line or small amounts of cable used in wire line services. Powered by a Wisconsin AEN 8.25 H.P. engine with a 6.1 clutch reduction. Super Duty Reel is capable of performing severe oil field wire line and conductor work and will carry 3000′ of 5/16″ dia. cable.

EXTRA-HEAVY DUTY POWER-DRIVEN

(Three Speed Transmission)

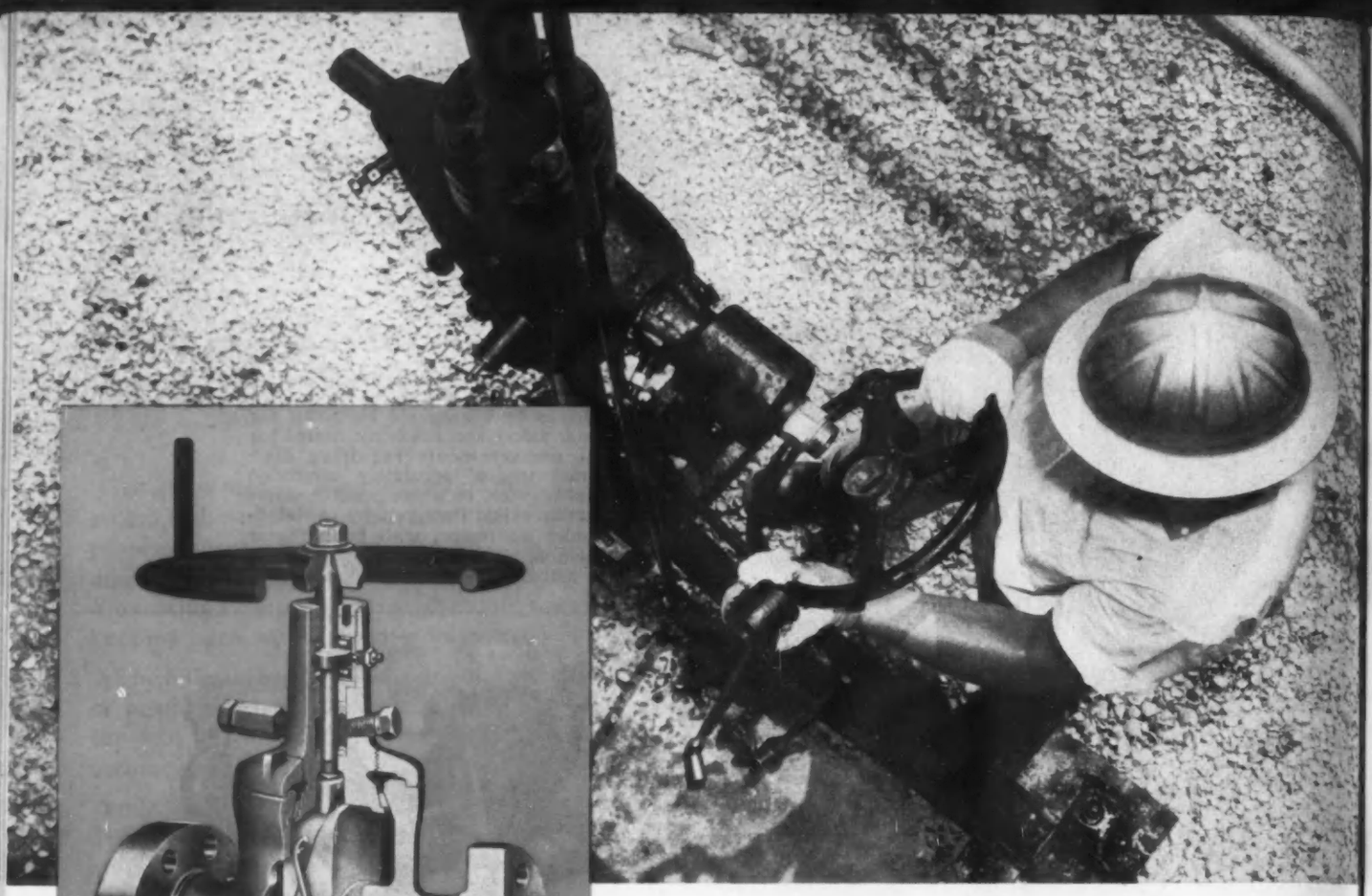
Designed for accurate and efficient measuring in the deepest wells under the most rugged conditions. Used where dependable electric AC power is available. Measuring Assembly is powered by a 5 H.P., 220-440 volt, 3 phase, 60 cycle uni-closed variable speed electric motor. (Explosion proof motor is available at additional cost.) The unit features a mechanical transmission, with three speeds forward and one speed in reverse, for operations where unusually low line speeds or maximum line pull are required. This Extra Heavy Duty Reel Assembly will carry 14,000′ of .092″ dia. measuring line.

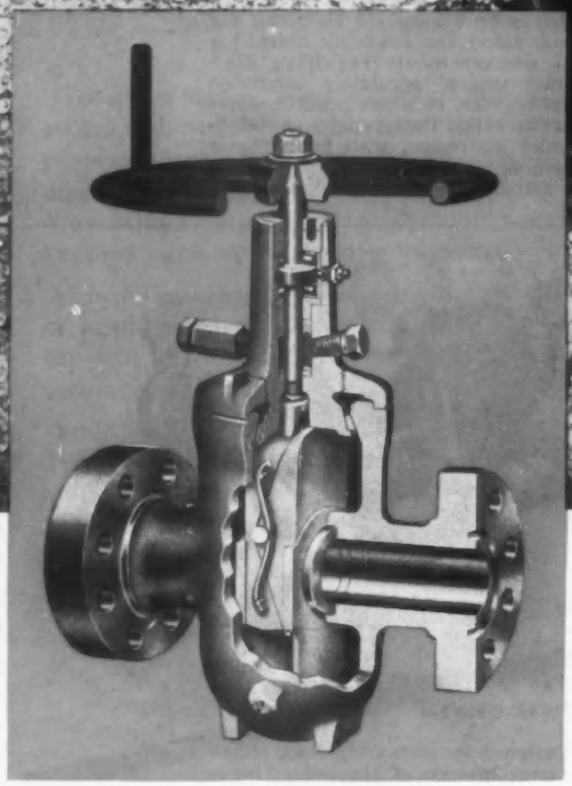


284 SERVICE CENTERS...TO SERVE YOU BETTER

HALLIBURTON MEASURING EQUIPMENT

HALLIBURTON OIL WELL CEMENTING COMPANY • DUNCAN, OKLAHOMA





Practical advantage of W-K-M's *Creative Engineering*:

On-the-line overhaul!

Fast, easy overhaul of W-K-M Gate Valves while on the line saves you time and money and contributes to the overall efficient performance and long-range economy that W-K-M valves are noted for.

Other benefits include parallel expanding gates, controlled force seating, free flow through the valve without any more turbulence or pressure drop than through a smooth-wall pipe, Teflon seat inserts (in all valves up to 5,000 psi working pressure), and superfinished stems.

Available in standard types, balanced stem*, recessed body, dual and triple completion types. Sizes range from 1½″ through 7″ for pressures ranging from 500 to 15,000 psi working pressure.

* *Illustrated above right*

Completely dependable

The superior performance of W-K-M production valves is attested by the experience of users.

These valves have earned a reputation that inspires confidence throughout the world. Field men recommend them; engineers specify their use.

W-K-M valves set industry standards for design . . . reliability . . . easy operation . . . and long-range economy.

On hand at your supply store

The most used sizes of W-K-M gate valves are carried by supply stores everywhere. Special sizes and special designs are produced as you need them.

WRITE FOR CATALOG 200
which describes W-K-M
Through-Conduit Gate Valves
for oilfield services.

W-K-M

DIVISION OF ACF INDUSTRIES
INCORPORATED
P. O. BOX 2117, HOUSTON, TEXAS
Export Office: 45 ROCKEFELLER PLAZA, NEW YORK, N.Y.

5819

Cementing and fracturing hose of steel, comprising Chiksan Joints and Weco Unions, have long been standard equipment with service companies.

new NEW

Chiksan has developed a new kind of swivel joint for oil well cementing. This joint has a wide turning radius and a new process-hardened steel to minimize cavitation and washout, plus a new wedge-shaped packing that cannot be sucked into the stream. It's called the Longsweep and it has produced highly spectacular results.

In two years of field testing, this new joint has proved itself better than any previous cementing joint ever used. Cementers report a minimum of 3-to-1 service life over old joints. This newest development is another Chiksan effort to reduce drilling costs.

CHIKSAN *Longsweep* SWIVEL JOINT

triples cementing hose service life . . .

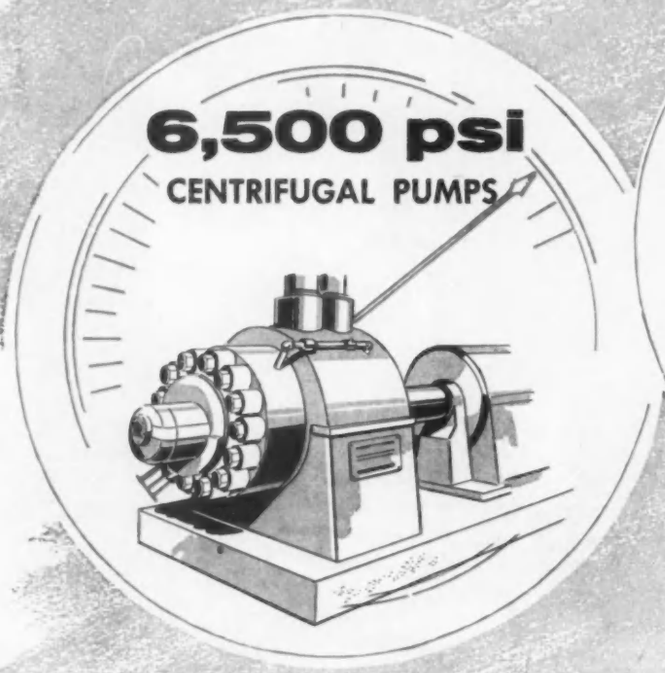
CHIKSAN fmc

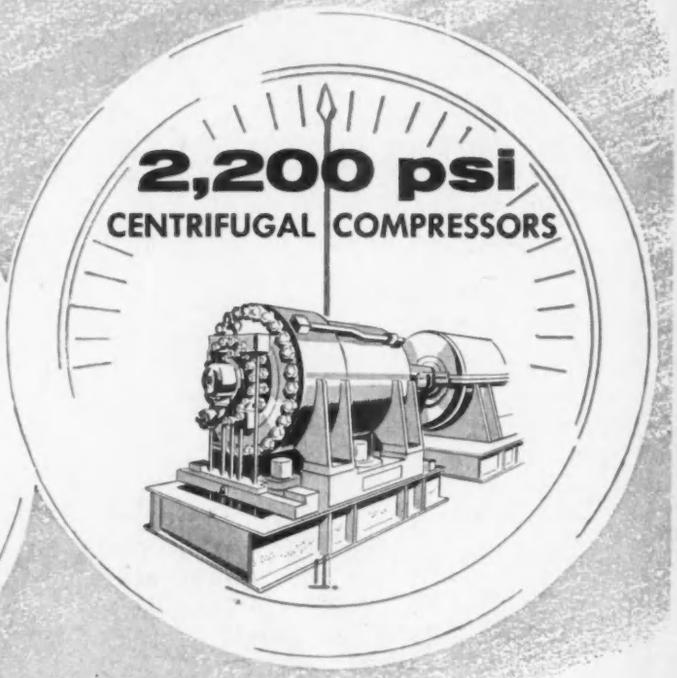
A SUBSIDIARY OF FOOD MACHINERY AND CHEMICAL CORPORATION

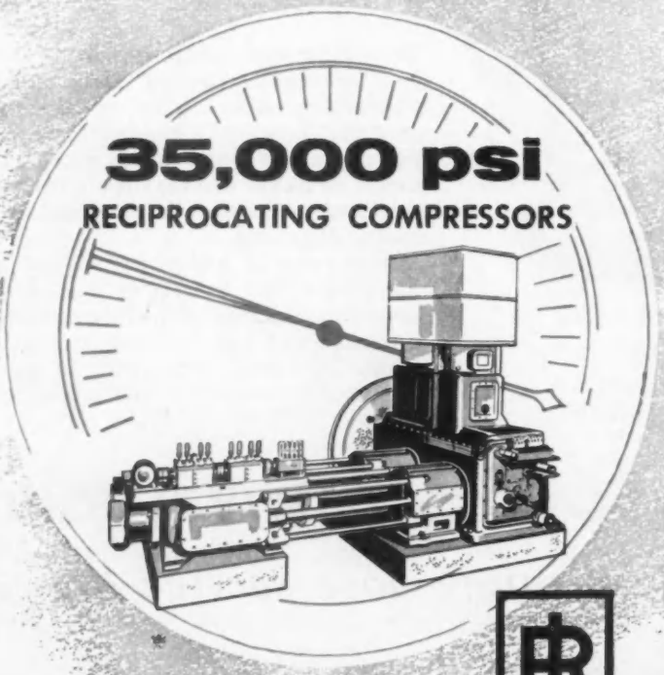
58-35

CHIKSAN COMPANY—Brea, Calif. • Chicago 5, Ill. • Newark 2, N. J. • Weco (Division), Houston 1, Texas • Subsidiaries: Chiksan Export Co. • Chiksan of Canada, Ltd.

hi-psi *







These gauges show high levels of gas and liquid pressures created by machines designed and built by Ingersoll-Rand.

Such pressures have not always been practical. Most top levels have crept up little by little as new processes in industry demanded higher and still higher pressures. Those indicated here are bold advances, much higher than the preceding highs. Each is another building block in the foundation of experience.

Through a half century of such experience Ingersoll-Rand has been closely associated with the process and petrochemical industries. If you need to compress a gas, or pump a liquid at any pressure you choose to call high, take advantage of Ingersoll-Rand's experience that has continuously set the pace in high-pressures.

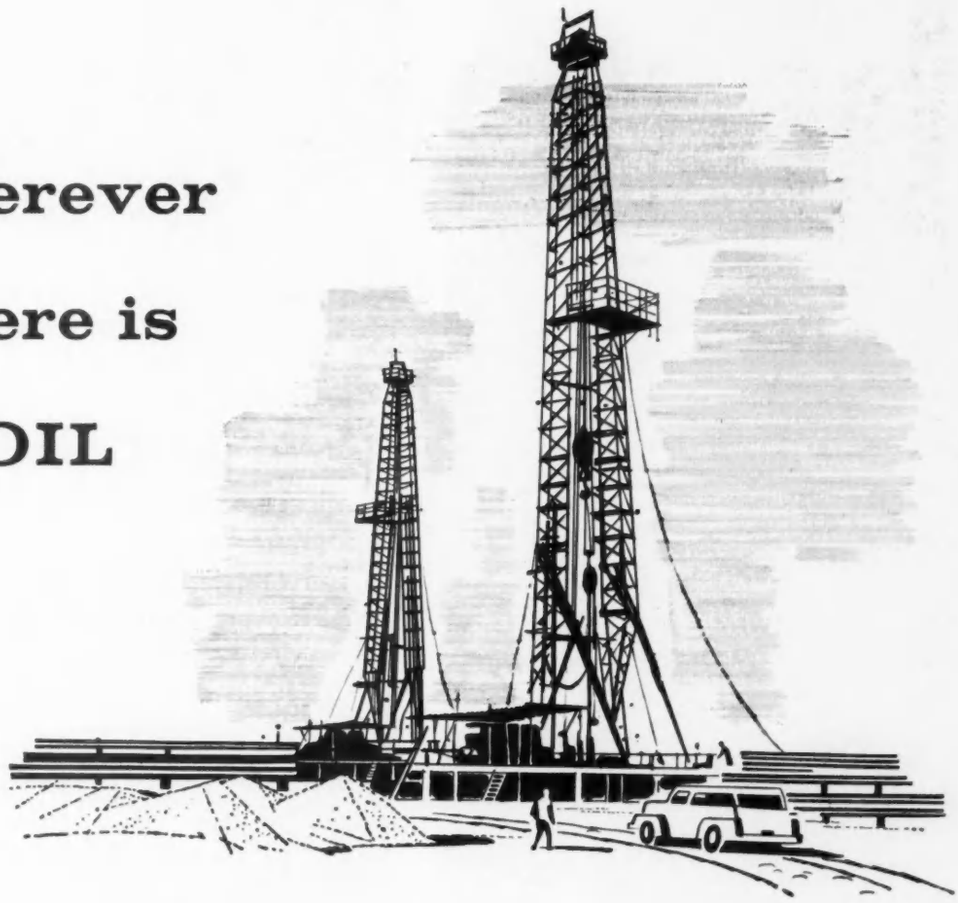
* **hi-psi** . . . high pressures, measured in pounds per square inch.

Ingersoll-Rand

I-681

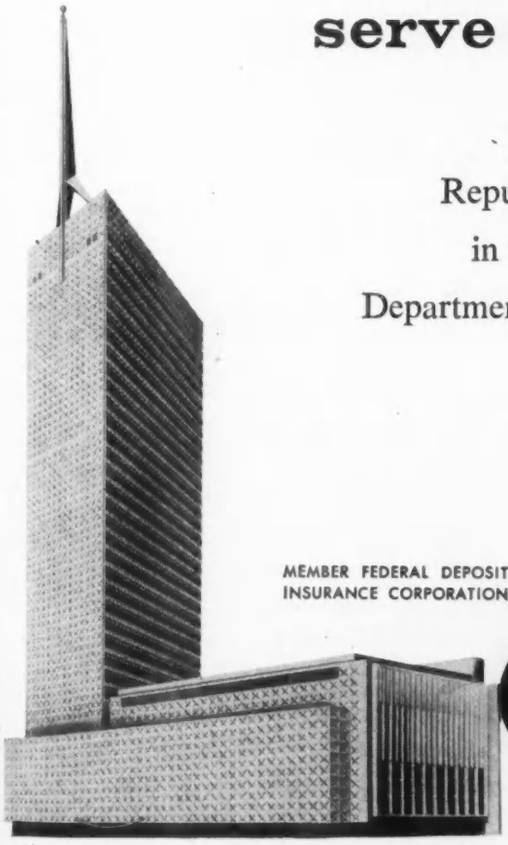
11 Broadway, New York 4, N. Y.

wherever
there is
OIL



...REPUBLIC stands ready to serve the Petroleum Producer

Oil production financing is more than a specialty at Republic National Bank of Dallas . . . it is a major factor in this Bank's leadership in the Southwest. Republic's Oil Department offers you the services of the South's largest staff of petroleum experts . . . men who know the right answer to your financing problem. It pays to . . . rely on Republic!



MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

ADDED STRENGTH YOU CAN BANK ON

REPUBLIC
National BANK of Dallas

CAPITAL FUNDS OVER $90,000,000
LARGEST IN THE SOUTH

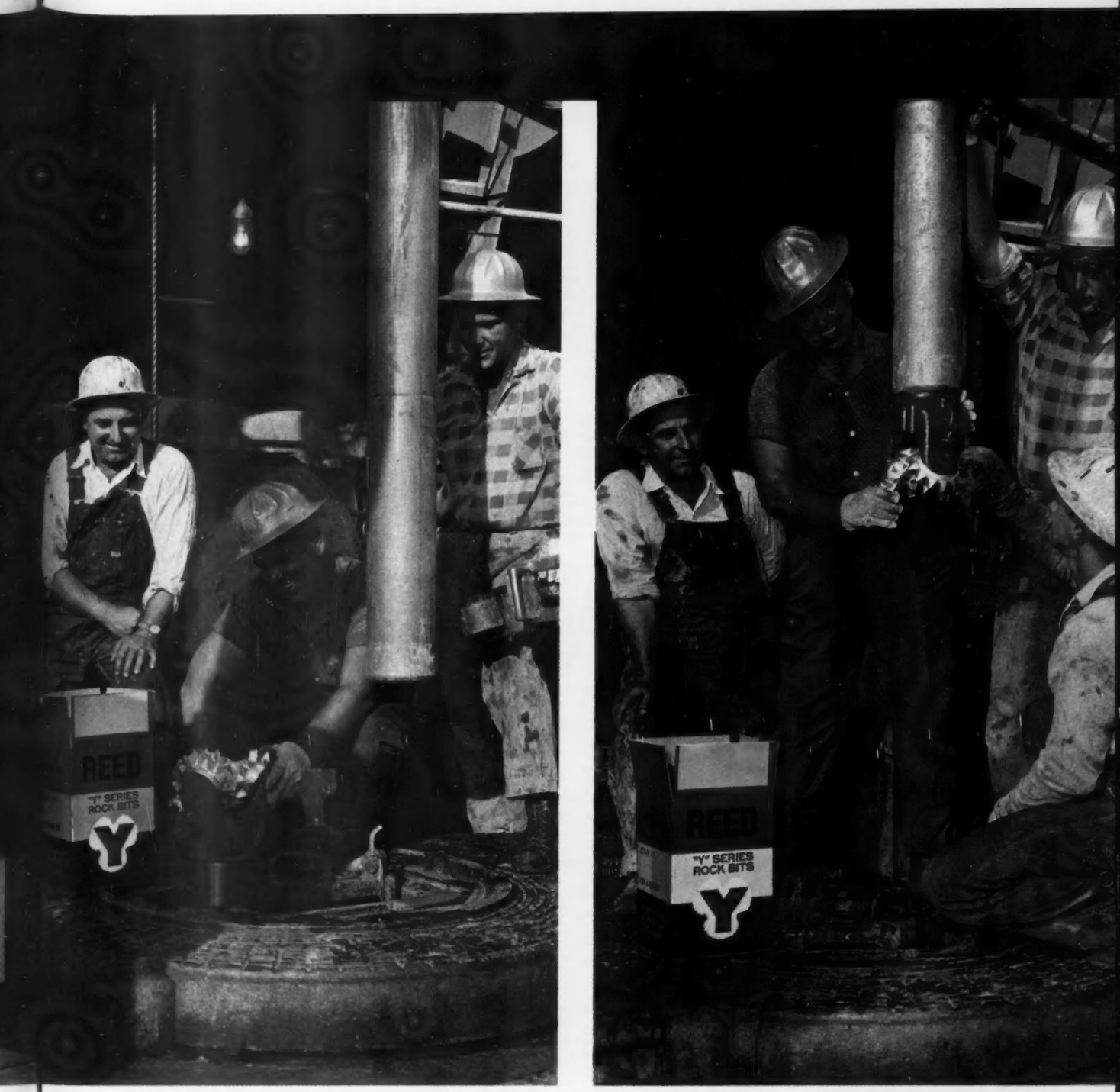
BIG THINGS HAVE HAPPENED AT REED ...AND THIS IS ONLY THE BEGINNING

Changes, improvements and progress have resulted in this vastly improved Reed "Y" Series Rock Bit.

Here you see the effect of continuing research pointed toward better bit performance. The result: the best rock bit modern engineering principles, thorough field testing, absolute quality control and exacting manufacturing can produce.

Let the new Reed box and bit colors serve as a daily reminder of the new Reed improvements in design, metallurgy, teeth and bearings. They are combined in perfect balance to give you faster penetration and full gauge hole in every formation you drill.

You'll be money ahead on your next well by running Reed bits all the way. Give your Reed Representative the opportunity to tell you in detail about this new bit or write for our new booklet, "The Why of the 'Y'."



REED'S ROLLIN'

REED ROLLER BIT COMPANY

Houston 1, Texas

EXPORT OFFICE: 1011 INTERNATIONAL BLDG., NEW YORK 20, N.Y.

GULF COAST, MID-CONTINENT, ROCKY MOUNTAIN AND CANADIAN DISTRIBUTOR FOR MARTIN-DECKER PRODUCTS.

For more data on advertised products, use Readers' Service Cards, last page.

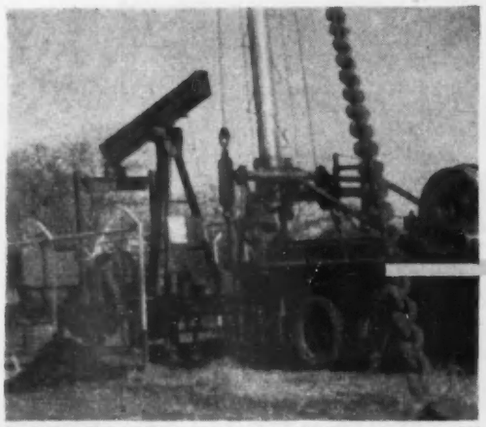
International Petroleum Exposition

May 14-23 **1959** • Tulsa, Oklahoma, U. S. A.

Night view of IPE with Tulsa Skyline

For Accommodations, write:
IPE Housing Bureau
Oil Capital Building, Tulsa, Oklahoma
For Space, write:
International Petroleum Exposition
P. O. Box 5205 Donaldson Station
Tulsa, Oklahoma
W. K. Warren, President
Wm. B. Way, General Manager

Dates of the IPE set in conjunction with World Petroleum Congress to be held in New York a week after the Tulsa Show



WHEN YOUR OPERATION LOOKS LIKE THIS

whether it's in a pumping well,
flowing well, flowline,
pipeline or storage tank . . .

BECAUSE OF THIS

efficiency-robbing paraffin deposits that
accumulate on well tubing and rods,
cut the effective diameter of pipe, or
cause a loss in valuable storage tank capacity . . .

TRETOLITE COMPANY
SOLVO®
SAINT LOUIS • LOS ANGELES

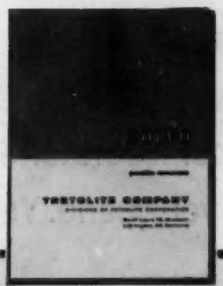
THEN YOU NEED THIS

THE SAFE, EFFICIENT CHLORIDE-FREE WAY TO REMOVE PARAFFIN DEPOSITS

SOLVO contains
neither carbon bisulfide
nor carbon tetrachloride

SEND FOR . . .

FREE Illustrated brochure!
(Send to Address Nearest You)



TRETOLITE COMPANY
369 Marshall Ave. • St. Louis 19, Mo.
5515 Telegraph Road • Los Angeles 22, California
Gentlemen: I'm interested in new chloride-free SOLVO.
Send new brochure.

Name_____

Address_____

City_____ Zone___ State_____

TRETOLITE COMPANY
DIVISIONS OF PETROLITE CORPORATION
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Chemicals and Services
for the Petroleum Industry

DEMULSIFICATION • DESALTING
CORROSION INHIBITING • PARAFFIN
REMOVAL • SCALE PREVENTION
WATER DE-OILING • INJECTIVITY
STIMULATION

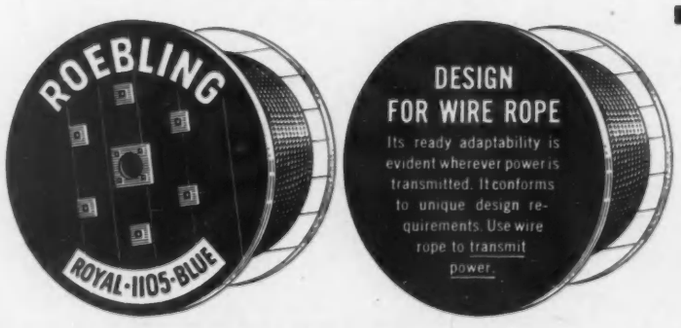
TPR-58-3

For more data on advertised products, use Readers' Service Cards, last page.

THERE IS NO BETTER TIME to take a close look at the wire rope you use. A look that assures you that for dollars spent you get **services rendered.** The rope you can look at with assurance is **Roebling Royal Blue Wire Rope.** It has been thoroughly tested in our laboratories and proved in the field. It will repay you in hard work for every dollar you spend. **You get your money's worth.** You get **Roebling Royal Blue Wire Rope.**

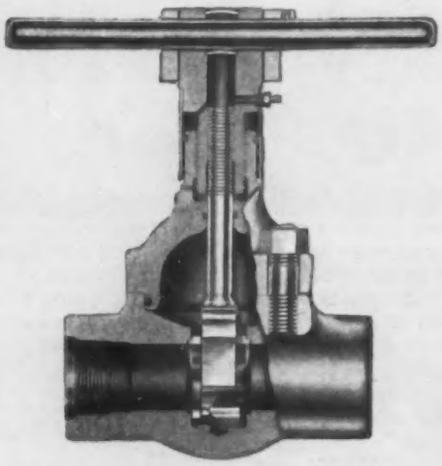
ROEBLING

Branch Offices in Principal Cities
Subsidiary of The Colorado Fuel and Iron Corporation

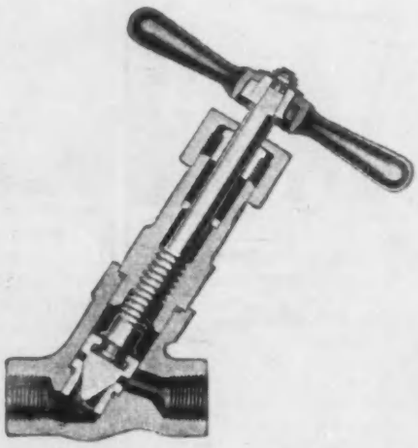

ROEBLING
ROYAL·1105·BLUE
DESIGN
FOR WIRE ROPE
Its ready adaptability is evident wherever power is transmitted. It conforms to unique design requirements. Use wire rope to transmit power.

WE REDUCED THE GAS-FLUID RATIO
ON OUR NO. 1 WELL BY 6,900 CU. FT./BBL. —
AND INCREASED OIL PRODUCTION 20 PER CENT —
WHEN WE SWITCHED TO TYPE F OTIS RETRIEVABLE GAS LIFT VALVES.
THAT GAVE US A 75 PER CENT REDUCTION IN THE AMOUNT OF GAS REQUIRED TO PRODUCE THE WELL, PLUS A DIRECT SAVINGS IN GAS COMPRESSION COSTS PER BARREL OF OIL PRODUCED. WHAT'S MORE, WE DIDN'T HAVE TO RESPACE THE MANDRELS TO DO IT. YOU SEE, THE TYPE F HAS A RESILIENT MAIN VALVE ELEMENT LIKE THIS IN IT WHICH ACTS AS A VARIABLE ORIFICE. THIS GIVES US CONTROL OF INJECTION GAS AT THE SURFACE. THERE ARE NO CHOKES IN THE VALVE TO RESTRICT GAS FLOW. IN FACT, THE TYPE F HAS AN EXTRA LARGE GAS FLOW PORT AREA TO PASS A MAXIMUM AMOUNT OF GAS AT A MINIMUM PRESSURE, WHEN NECESSARY.
THIS IS HOW THE TYPE F WORKS. THE AREA ABOVE THE SLOTTED PORTS IS THE DOME PRESSURE AREA. PRESSURE IN THE DOME HOLDS THE MAIN VALVE ELEMENT CLOSED ACROSS THE SLOTS IN THE VALVE BODY. THE MAIN VALVE FLEXES TO ADMIT GAS WHEN PRESSURE IN THE ANNULUS EXCEEDS THE SET PRESSURE OF THE VALVE BY AS LITTLE AS ONE OR TWO POUNDS. INCIDENTALLY, BOTH THE DOME AREA AND THE PORT AREA IN THE TYPE F OTIS VALVE ARE EXTRA LARGE.
GAS ENTERS THROUGH THE PORTS, PASSES THROUGH A FINNED RETAINER, ACROSS THE RESILIENT CHECK VALVE (WHICH IS NORMALLY CLOSED), AND OUT THE BOTTOM OF THE VALVE. BECAUSE OF THE DESIGN, THE VALVES HAVE BUT ONE OPENING AND CLOSING PRESSURE — THAT'S THE PRE-SET PRESSURE.
ONE REASON TYPE F SERIES OTIS VALVES ARE SO EFFICIENT IS BECAUSE OF THE CHECK VALVE. AS I SAID, IT'S NORMALLY CLOSED — DOESN'T REQUIRE VELOCITY TO CLOSE; OPENS ONLY TO PASS THE SYSTEM GAS DURING INJECTION; GIVES A BUBBLE-TIGHT SEAL EVEN IN SAND-LADEN FLUIDS, AND ELIMINATES VALVE WASH-OUT.
THERE ARE MANY OTHER ADVANTAGES IN USING OTIS RETRIEVABLE GAS LIFT VALVES. THEY HAVE NO MOVING METAL PARTS, NO METAL BELLOWS TO FATIGUE, NO METAL-TO-METAL SEAL NOR STEM AND SEAT TO WEAR AND CUT OUT, AND YOU DON'T HAVE TO RETRIEVE OR MODIFY THE VALVES TO CHANGE FROM CONTINUOUS TO INTERMITTENT LIFT, OR VICE VERSA.
IF YOU HAVE M OR K SERIES ECCENTRIC SIDE-POCKET MANDRELS IN YOUR WELLS, AND YOU'RE LOOKING FOR WAYS TO IMPROVE THE EFFICIENCY OF YOUR GAS LIFT INSTALLATIONS, YOU SHOULD RUN TYPE F OR FK OTIS RETRIEVABLE GAS LIFT VALVES. YOU'LL GET BETTER CONTROL OF YOUR GAS — AT THE SURFACE, WHERE YOU WANT IT — WHICH CAN MEAN A LOWER LIFTING COST. GIVE YOUR WELLS A NEW LIFT — RUN OTIS GAS LIFT VALVES.
OTIS — "First in Gas Lift Control"
OTIS
OTIS ENGINEERING CORPORATION
General Offices: 2312 Denton Drive Dallas
Branches Throughout the Oil Country

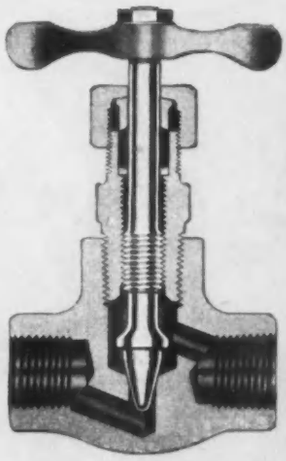
Rockwell-Built Edward Steel



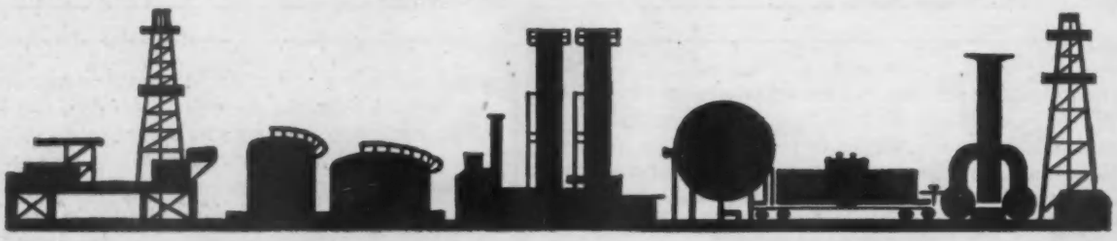
MUDWONDER MUDLINE VALVES
Figs. 2128-3128
For pressures to 2,000-3,000 lb WOG
Bolted bonnets, screwed or flanged ends

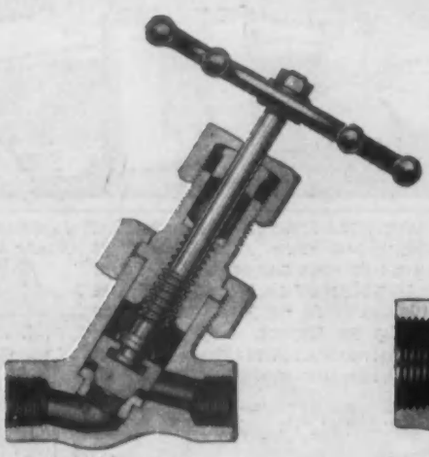


GLOBE STOP VALVE
Fig. 158
For pressures to 10,000 lb WOG
Screwed bonnet, screwed or socket welding ends

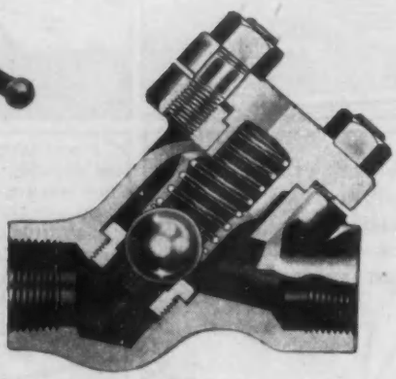


GLOBE GAGE VALVE
Fig. 152
For pressures to 4,000 lb WOG
Screwed or union bonnet, screwed ends

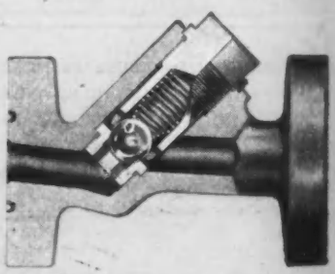




GLOBE STOP VALVE
Fig. 2698
For pressures to 2,000 lb WOG
Union bonnet, screwed or socket welding ends



BALL CHECK VALVE
Fig. 4632
For steam pressures to 600 lb A.S.A. (2,000 lb WOG)
Horizontal or vertical
Bolted cover, screwed or socket welding ends



BALL CHECK VALVES
Figs. 5160-9160
For pressures to 5,000-10,000 lb WOG
Horizontal or vertical, screwed covers, flanged ends

Valves Work Everywhere

in drilling...production...refining...

Edward valves are on the job, no matter where you look. From the towering derricks of Northern Alberta to offshore rigs on the Gulf . . . from refineries on the Jersey Flats to California natural gas plants . . . the word is—"You buy a better valve from Edward!"

Edward Globe Valves

Bodies are drop-forged steel, for greater strength and resistance to erosion. Large-diameter handwheels permit operation without a wrench or cheater; cross-arm Impactor* handle for quick, tight closing is standard on 2" Fig. 158. Figures 158 and 2698 have replaceable seats. Disks—both plug and needle types—are carefully aligned, and seats are lapped for tight sealing. Stems are EValloy,* an exclusive Edward stainless steel, centerless ground to a fine finish. Carefully machined Acme stem threads assure easy operation. Bonnet threads plated by an exclusive EValizing* process for maximum resistance to wear and corrosion. Deep stuffing boxes, with exclusive EValpak* asbestos-graphite packing, assure a tight seal with minimum resistance to stem turning.

Edward Ball Check Valves

Identical to Edward globe stop valves in body and seat features. Rolled steel bonnet with integral ribs to guide ball accurately. Ball is corrosion-resistant high carbon stainless steel, precision-ground for tight seating. High carbon stainless steel spring gives positive aid in seating ball.

Edward Mudwonder Valves

Body and bonnet are high-strength alloy steel with heavy body-bonnet cover flanges. Accurately machined to assure drop-tight sealing under extreme pressures. Double-threaded yoke bushing, completely enclosed, gives 2-to-1 ratio. Corrosion-resistant stainless steel stem with slotted gate coupling to eliminate bending or binding. Gate is hard chrome plated to reduce friction, resist erosion and abrasion. Seat insert of resilient buna–N synthetic rubber, molded integrally over steel wear rings. Seat and gate easily replaced without removing Mudwonder* from line.

WHERE CAN YOU USE EDWARD VALVES?

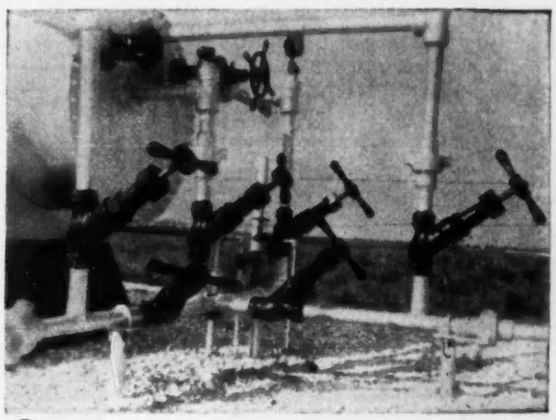
Our customers report complete satisfaction in the use of Edward valves for water flood service . . . throttling . . . on high-pressure heaters, treaters and separators . . . on pressure vessel controls . . . on headers and flow lines to heaters and exchangers . . . for manifold service . . . in gasoline or gas sulfur extraction plants . . . for "unloading" valves at gas compressor stations . . . and in many other applications. You name your need . . . let your Edward representative show how to fulfill it with versatile, economical, completely dependable Edward valves. They are available from your favorite oil field supply store, from your industrial distributor, or direct from *Edward Valves, Inc., 1200 W. 145th Street, East Chicago, Indiana* (Subsidiary of Rockwell Manufacturing Company). Represented in Canada by Lytle Engineering Specialties, Ltd., Montreal, and Rotary Sales & Service, Ltd., Edmonton.

EDWARD STEEL VALVES

another fine product by

ROCKWELL

Edward builds a complete line of forged and cast steel valves from ¼" to 18"; in globe and angle stop, gate, non-return, check, blow-off, stop-check, relief, hydraulic, instrument, gage and special designs; for pressures up to 10,000 lbs; with pressure-seal, bolted, union or welded bonnets; with screwed, welding or flanged ends. *T.M. Reg. U.S. Pat. Off.



Edward 2" Fig. 158 valves in service on heater by-pass lines in Louisiana oil fields. Note Impactor handles for quick, easy closing against high pressures.

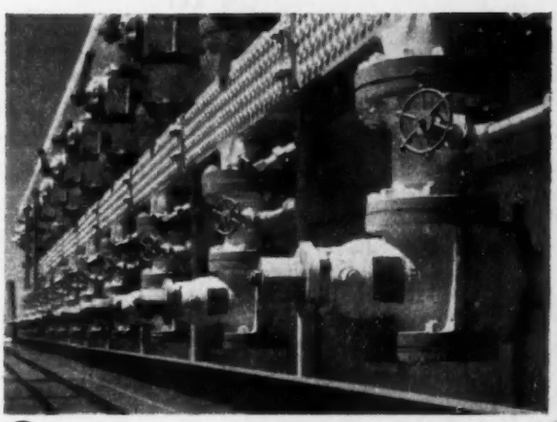
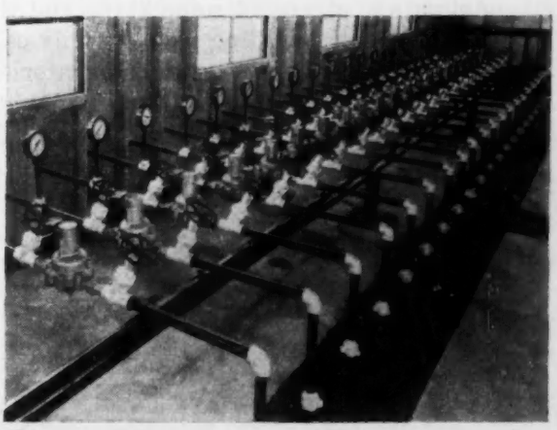


Fig. 2698 valves on cooling coils of natural gas cooler. Scene: New Mexico field processing plant. Lubricated plug valves in photo are Rockwell-Nordstrom.



Forty-two Edward forged steel globe valves (Fig. 2698) throttle the flow on this West Texas water flood. Owner reports absolutely no maintenance costs in two years (over 4,000,000 barrels of water)!

Here's how a Dorr-Oliver ClayJector saved $32,569 in 41 days of drilling!

Cyclone action does it!

The action of the Dorr-Oliver ClayJector is demonstrated above. Cyclonic forces up to 8,000 "g's" developed when mud is whirled under pressure in a conical DorrClone® classifier, cause heavy barite solids to be thrown to the walls and down to the apex valve at the bottom, while lighter solids are discharged at the overflow at the top. Four DorrClones manifolded about a common feed, overflow and underflow housing form a complete unit.

Maximum recovery of barites for re-use and elmination of troublesome clays and drilled solids from the drilling mud not only pays off in savings of valuable weighting material, but also results in faster drilling and longer bit life.

The key to these savings is the Dorr-Oliver ClayJector classifier, developed for oil-field service through the combined efforts of Dorr-Oliver, Inc. and Salt Water Control, Inc.; it represents today's latest development for optimum control of weighted muds. A recent cost comparison analysis of one hole drilled without a ClayJector and a sidetrack hole drilled with it showed that savings with the ClayJector amounted to $32,569 in 41 days—or $795 per day!*

The ClayJector is mechanically simple, contains no moving parts, operates with minimum attention. For more information, contact our U. S. Sales Representative, Salt Water Control, Inc., 1211 Fort Worth National Bank Building, Fort Worth 2, Texas.

**Name and Statistics available on request.*

ClayJector & DorrClone are Trademarks of Dorr-Oliver Incorporated

DORR-OLIVER
INCORPORATED
WORLD-WIDE RESEARCH • ENGINEERING • EQUIPMENT
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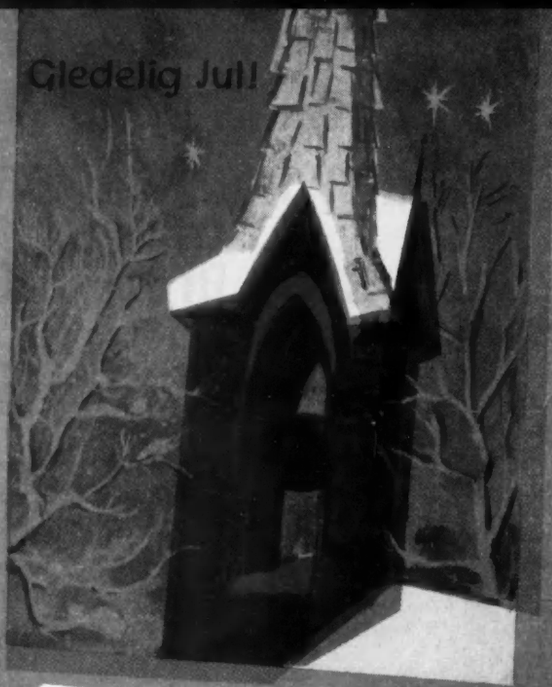
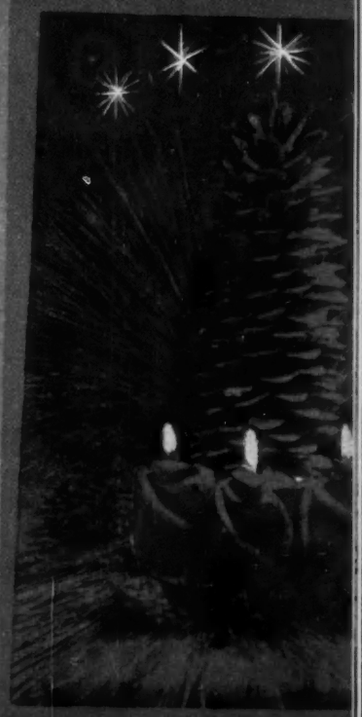




SEASONS GREETINGS

WE FEEL THAT THIS YEAR SHOULD NOT PASS WITHOUT OUR EXPRESSION OF FRIENDSHIP. WE WISH YOU AND YOURS A HAPPY AND PROSPEROUS NEW YEAR

oilmaster PUMPS

FLUID PACKED PUMP CO.
PLANT AND MAIN OFFICE, LOS NIETOS, CALIFORNIA

"Neoprene coated nylon shelters have given us dependable, low cost protection"

reports Mr. Wendell C. Peel, President, Peel Brothers, Inc., Drilling Contractors

"For the past four years, we have used neoprene coated oil rig shelters and have been satisfied with their performance," continues Mr. Peel. "Where frequent moves and quick rigging up are involved, a lightweight shelter means less bulk, and less time needed to put the shelter in place."

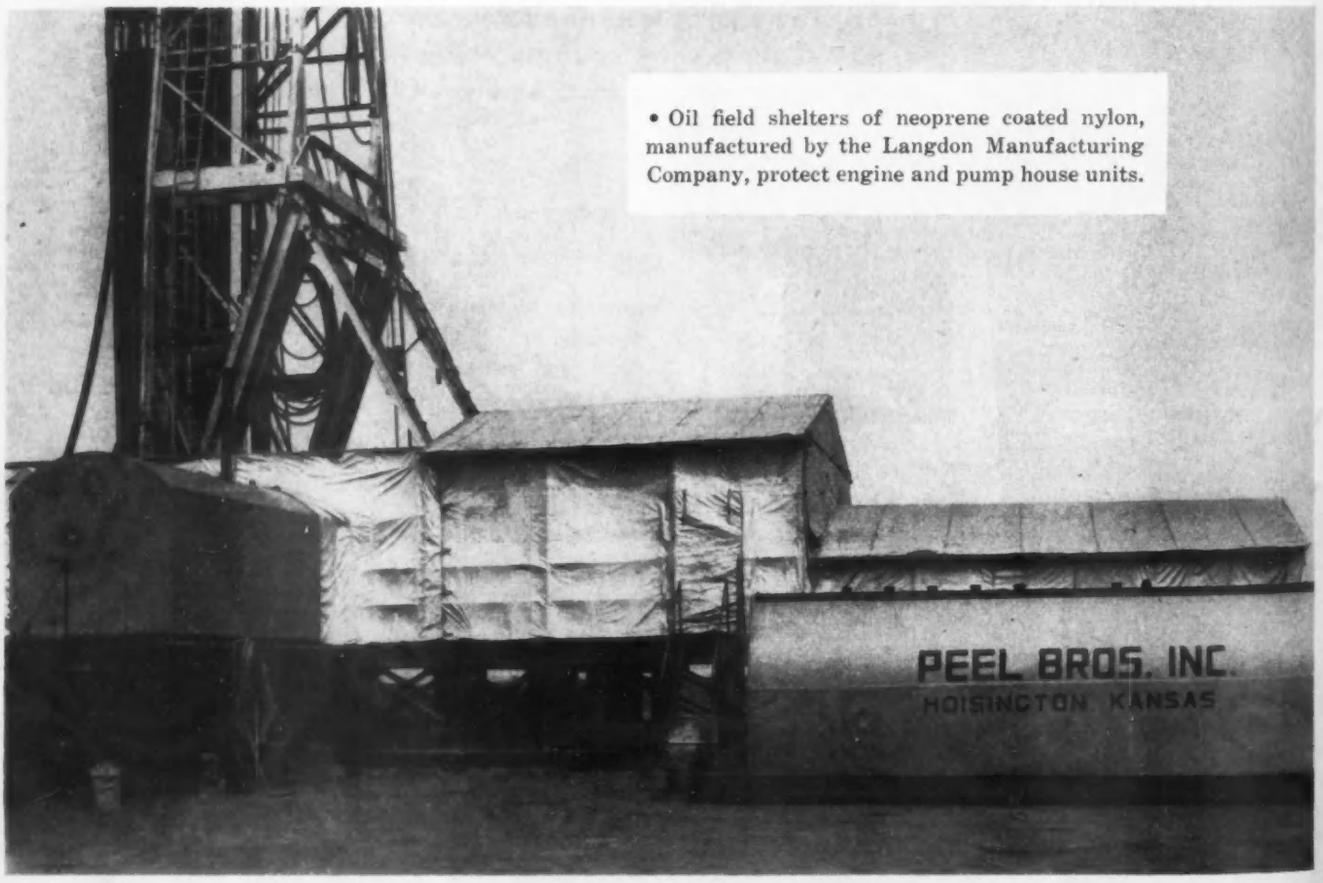
Neoprene coated nylon shelters can be quickly erected and easily dismantled; keeps crating costs to a minimum. A neoprene coating is weather resistant. It retains its flexibility during summer heat and low winter temperatures . . . provides durable protection from snow, sleet, rain and sun. Drilling rigs can be operated at higher efficiencies and with lower operating costs when men and equipment are sheltered from severe weather conditions. In addition to being oil and grease resistant, neoprene will not support combustion.

Du Pont neoprene is outstanding among synthetic rubbers for its ability to give long, trouble-free service under adverse conditions. Hose, pipe wipers, portable storage tanks, gaskets, desander liners are just a few of the oil field products made with neoprene. Ask your supplier for more details about neoprene oil field products. E. I. du Pont de Nemours & Co. (Inc.), Elastomer Chemicals Dept., Wilmington 98, Delaware.

DU PONT
*REG. U. S. PAT. OFF.

NEOPRENE

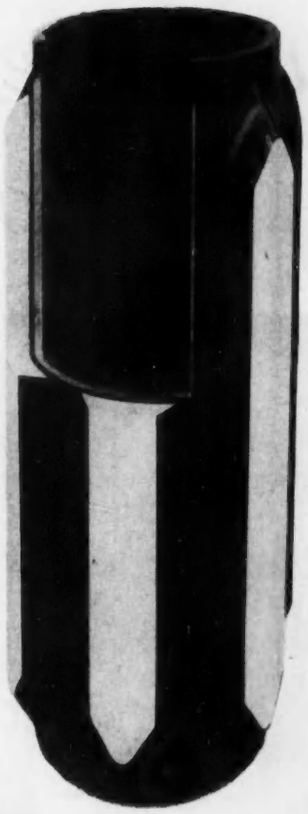
Better Things for Better Living
. . . through Chemistry



• Oil field shelters of neoprene coated nylon, manufactured by the Langdon Manufacturing Company, protect engine and pump house units.

NEW

ALUMINUM RIB STABILIZER



For drilling straighter holes in crooked hole country. Proven safe, dependable and economical in extensive field testing in the mid-continent area.

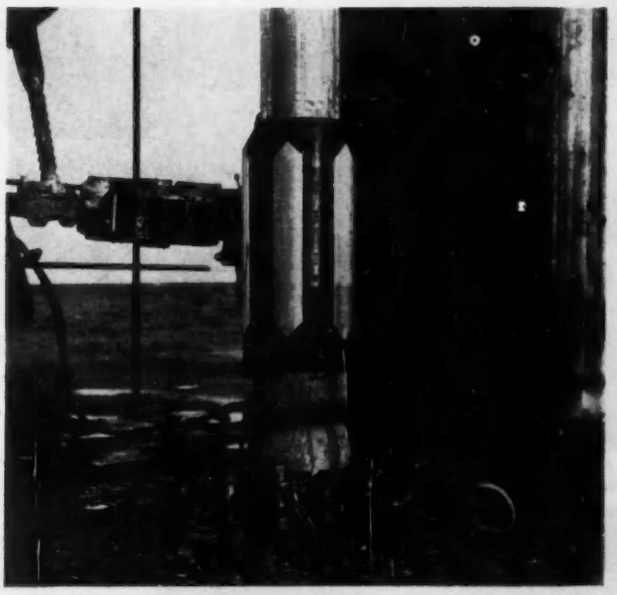
The aluminum ribs are bonded to the body of the stabilizer sleeve with rubber to provide flexibility. New design "prow-like" ends of ribs channel drilling fluid and cuttings into deeper spaces between ribs to provide better circulation passage.

SAFETY FEATURES INCLUDE:

- Aluminum ribs readily drillable in case of "wash-over."
- Drilco safety lock prevents rotation of sleeve during "wash-over."
- Free vertical travel of sleeve on body acts like a jar to free sleeve in tight hole.
- Long fishing neck below all joints provides easy pick up with overshot in case of joint failure.
- Centering effect of stabilizer holding drill collars off wall of hole prevents "wall sticking"

FIRST

to build non-rotating stabilizers for ALL FORMATIONS.



Aluminum Rib For — shale — anaydrite and salt — softer unconsolidated formation

Rubber Rib For — lime — dolomite — chert — harder consolidated formation

DRILCO OIL TOOLS inc.

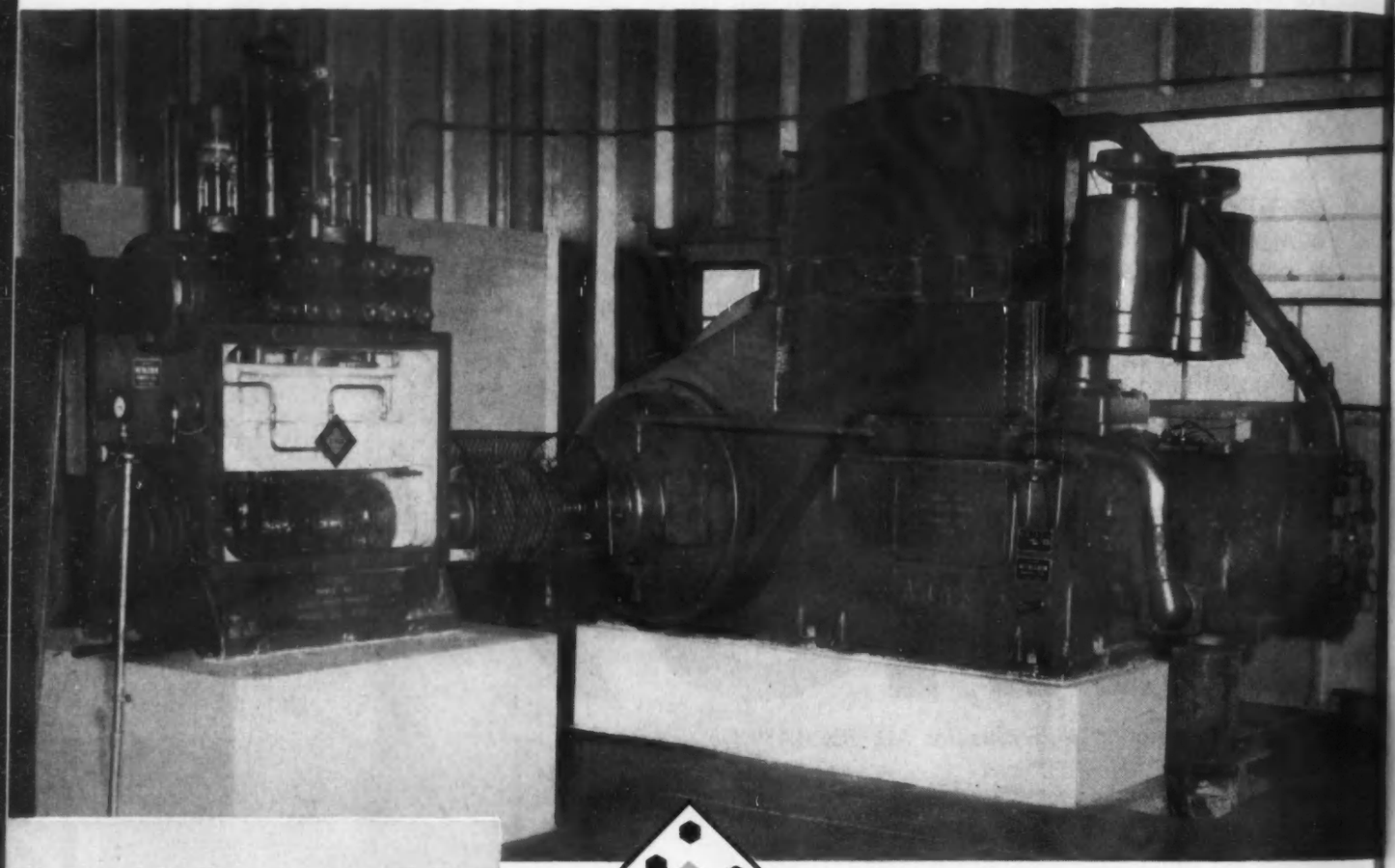
Drawer 3135 Midland, Texas

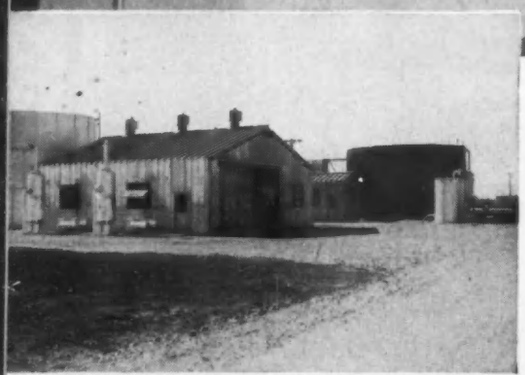
Drill Collar Stabilizers — Rotary Reamers — Drill Collars
Subs — Drill Collar Torque Indicators

The Aluminum Rib Stabilizer is a new tool . . . a research development

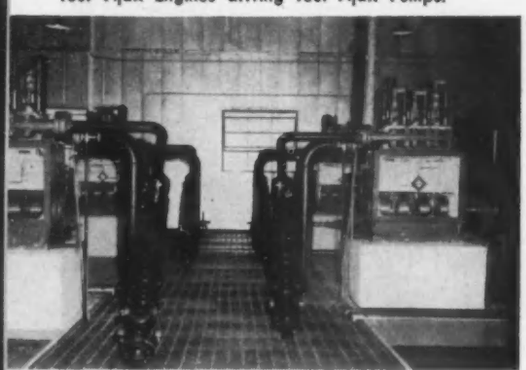
FROM DRILCO

You can be sure when you go Ajax all the way!





A modern West Texas waterflood installation—four Ajax Engines driving four Ajax Pumps.



AJAX

GAS ENGINES PRESSURE PUMPS

The good hard sense in going "AJAX all the way" shows up year after year. Match an Ajax Gas Engine with an Ajax Pump and you get a balanced workhorse team. You get undivided responsibility for maintenance. You benefit by a single interest of the builder in the performance of engine and pump alike. • Small wonder that experienced production men agree, "If you want to be *sure* of your waterflood jobs—go AJAX all the way!" *Ask your supply man.*

Ajax IRON WORKS

Builders of GAS AND OIL ENGINES • PRESSURE PUMPS

CORRY, PENNSYLVANIA

Oil Field Distributors: THE NATIONAL SUPPLY CO., PITTSBURGH, PA. • R. B. MOORE SUPPLY CO., BOLIVAR, N. Y. • BETHLEHEM SUPPLY CO., TULSA, OKLAHOMA

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INTERNATIONAL DISTRIBUTORS

of Quality Oil Well Drilling Equipment

Beck "Melloblu" Gas Burners
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Mission Pistons, Liners, and Valves
Parkersburg Derricks, Brakes, and Tanks
Pittsburgh Steel Oil Country Tubular Goods
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Reed Rock Bits and Tool Joints

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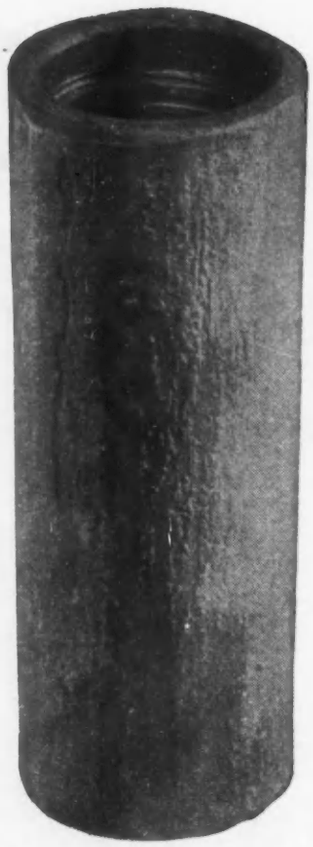
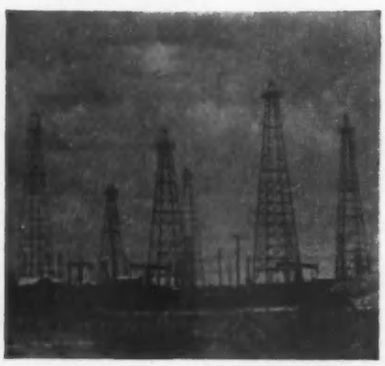
Calgary and Edmonton, Alberta, Canada
West Building, Houston, Texas

BEFORE RODINE was adopted. Note the complete breakdown of the walls of the down-well tubing and casing.



AFTER RODINE was put to use. Though the well is highly acidic, little corrosion of the tubing and casing occurs now.

ACP Rodine® INHIBITS CORROSION IN SWEET WELLS, CONDENSATE WELLS, AND SECONDARY RECOVERY OPERATIONS—COSTS ONLY PENNIES A DAY



For just a few pennies a day you can minimize corrosion that costs you thousands of dollars annually. ACP Rodine will inhibit corrosion, cut maintenance and replacement costs, help prevent loss of production. It is readily soluble in water and brine, is effective over 200°F, can be added to the well by slugging (since it is heavier than the crude, it rapidly sinks into the water layer at the bottom of the well), or by proportioning pumps. And it does not promote or stabilize emulsion.

Specify whether your corrosion problem is in sweet wells, condensate wells, or secondary recovery operations. We'll send technical data and samples. Or our field engineering staff will cooperate with you in corrosion studies, including coupon service and fluid analysis.

Amchem Products, Inc. Ambler 28, Pa.

Formerly AMERICAN CHEMICAL PAINT COMPANY

CHEMICALS ACP PROCESSES

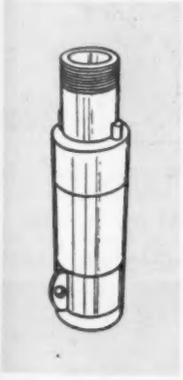
DETROIT, MICH. • ST. JOSEPH, MO. • NILES, CALIF. • WINDSOR, ONT.

New Chemical Horizons for Industry and Agriculture

Theo N. Law, Falcon Seaboard's diesel electric, submersible drill barge, equipped with Goodall Rotary Hose.

Rx Goodall Rotary Hose

prescribed when only the best is good enough



For example, Falcon Seaboard could not afford less than the best rotary hose for their shallow-water drill barge. Consequently, Goodall Rotary Hose was selected to be used on the barge's 1500 hp mud pump—the largest on the market. The Theo N. Law was still on location and drilling beyond 14,987 feet when last reported. Guaranteed Goodall Rotary Hose continues to give dependable performance.

For a rotary hose that will withstand the highest drilling pressures produced on any rig now in use—specify Goodall. It's good economics, because only Goodall hose has these outstanding features:

The Barney Coupling • The Goodall Safety Clamp • The Goodall Repair Service
The Goodall One-Year Guarantee

GOODALL RUBBER COMPANY

TRENTON, N. J.

Goodall Rubber Company of Texas: Houston and Odessa

Goodall Rubber Company: New York, Philadelphia, Pittsburgh, Chicago, Denver, St. Paul, Detroit, San Francisco, Los Angeles, Seattle, Salt Lake City, Portland.

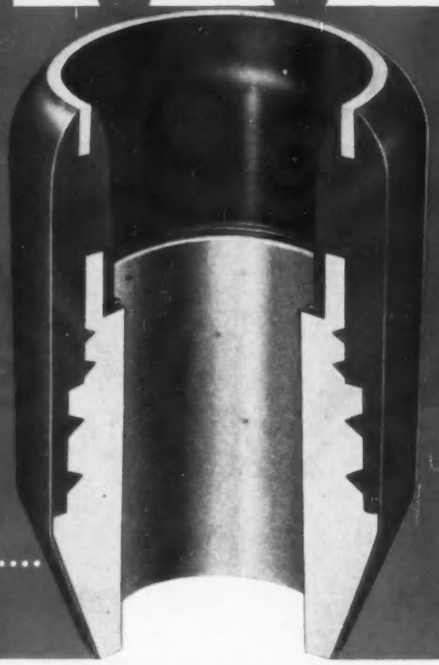
Export: Goodall Rubber Company, Trenton, N. J.

Stocking Distributors: Texas and Louisiana — Houston Oil Field Material Co., Wilson Supply Co., Hunt Tool Co., Heap Equipment Company, Iverson Supply Co.

Available through all qualified supply stores.

NEW

MARK I CUP TYPE SWAB



PATENT PENDING

Companion to the Proved E-Z Swab, the new Mark I Cup Swab uses the same mandrel but different rubbers. Mark I is a heavy duty positive displacement type swab able to lift a fluid load of from 1,200 feet to the heaviest loads encountered. Mark I was designed for use where the unique features of the E-Z Swab are not required. Heart of the Mark I—see cutaway—is a solid steel reinforcing core. This solid steel core can't wear, bend, and break as conventional reinforcing wires can. Can't hang up in tubing the way wires can. The new Mark I falls fast and comes out full. All this and the famous Mission Guarantee: "In a competitive test it will outperform all others or your money back." Order through your favorite supply store. Get your copy of the new brochure.

Nothing but the finest will bear the name of **MISSION** MANUFACTURING CO.

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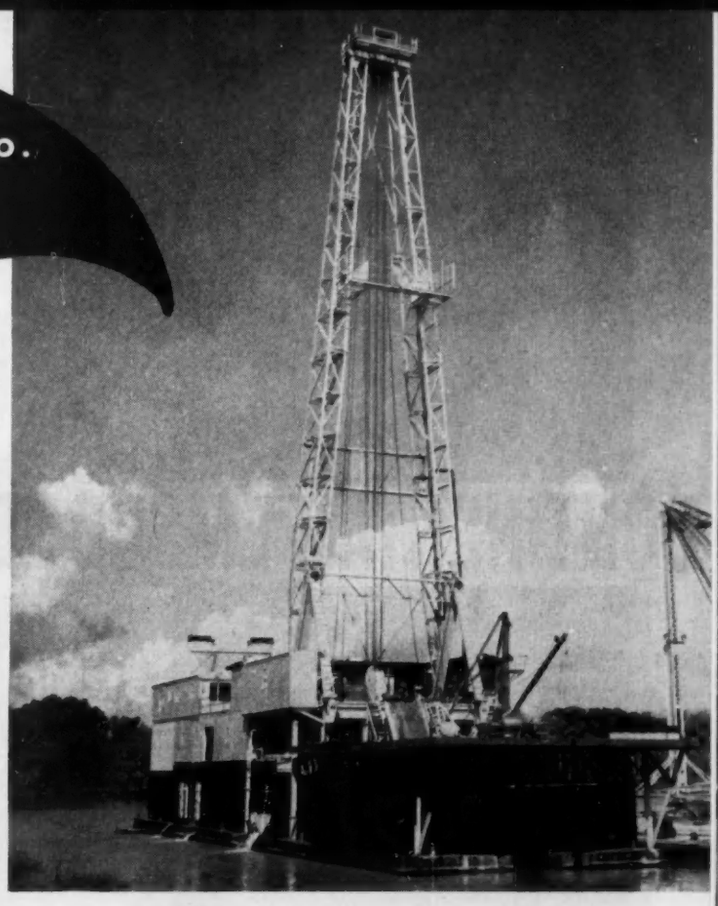
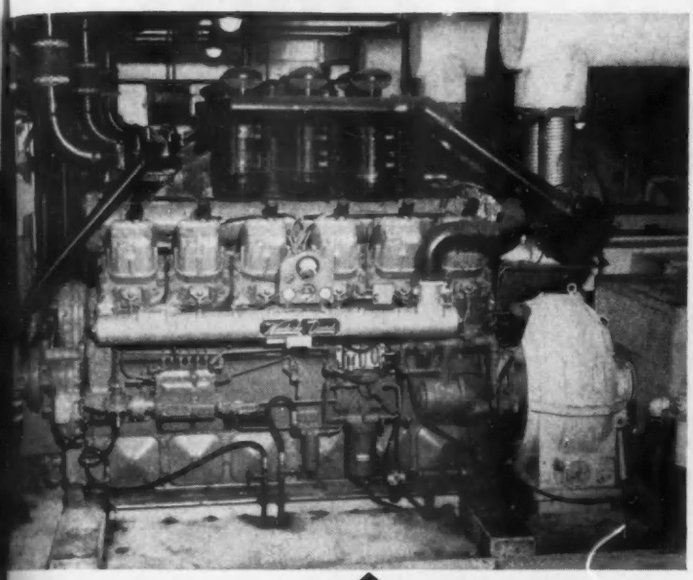
P·E·S·A PARTNERS IN PETROLEUM PROGRESS

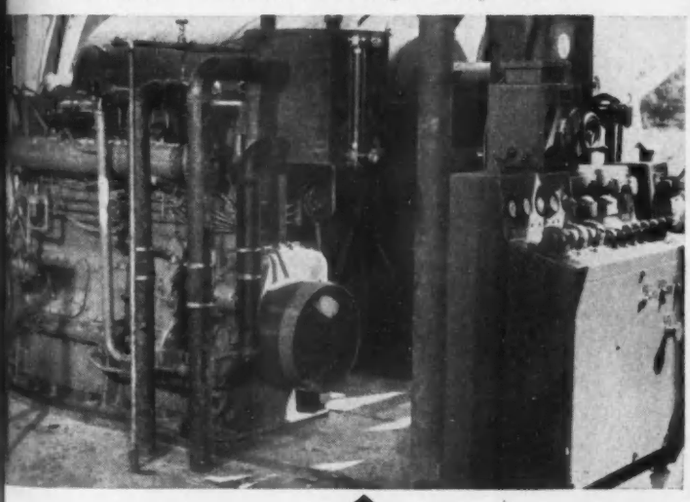
59-300

NEW Two-R Drilling Co. BARGE No. 1





(drilling engines—drawworks and mud pumps)
Three Waukesha VLRDBSU Turbocharged 12-cyl. Diesels



(rotary table drive and catworks)
Waukesha NKDBSU Turbocharged Diesel

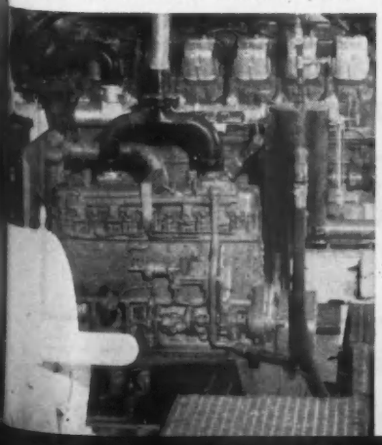
all-WAUKESHA POWERED

Recently commissioned at Morgan City, La., Barge No. 1 has a 25,000′ capacity drilling rig. The mast, 142′ high x 32′ at base, has 1,000,000 lb. lifting capacity. Barge is completely powered by Waukesha Diesel Engines, each of which has its own heat exchanger-surge tank system. The barge itself is 170′ long, 45′ wide, 12′ deep, with a substructure 24′ high; has living quarters for 22 men. It was built for Bethlehem Supply Co. by Reagan Tool Co. for delivery to Two-R Drilling Co. Reagan Equipment Co. supplied the Waukeshas. Get bulletins.

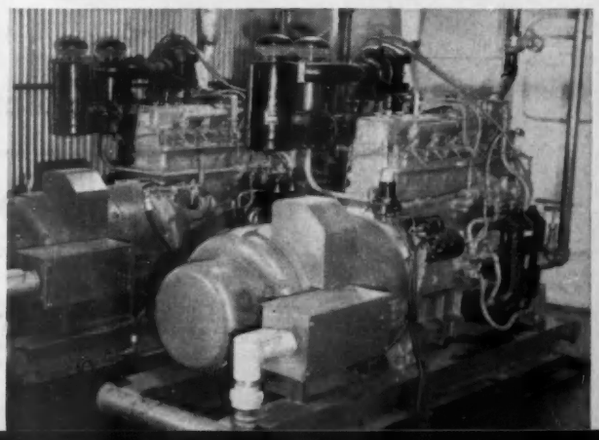
WAUKESHA MOTOR COMPANY, WAUKESHA, WISCONSIN
New York • Tulsa • Los Angeles

396

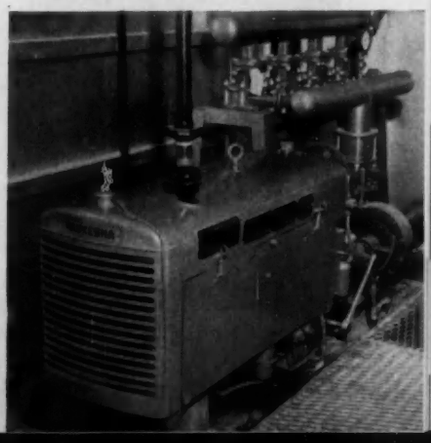
(mud mix pump)
Waukesha WAKDU Normal Diesel



(main electrical power) Two Waukesha WAKDBSU Turbocharged Diesel 125 KW Enginators



(de-sander unit)
Waukesha 190-DLCU Normal Diesel



YOUR DRILLING DOLLARS GO FURTHER WITH

..FIELD PROVEN

CONTINENTAL-EMSCO "D" Series Slush Pumps

These six models meet all conditions from light portable rigs to high-pressure deep well drilling:

D-175 175 h.p.—10,700 lbs.

D-300 300 h.p.—16,900 lbs.

DA-500 500 h.p.—28,000 lbs.

D-700 700 h.p.—37,500 lbs.

DA-850 850 h.p.—49,000 lbs.

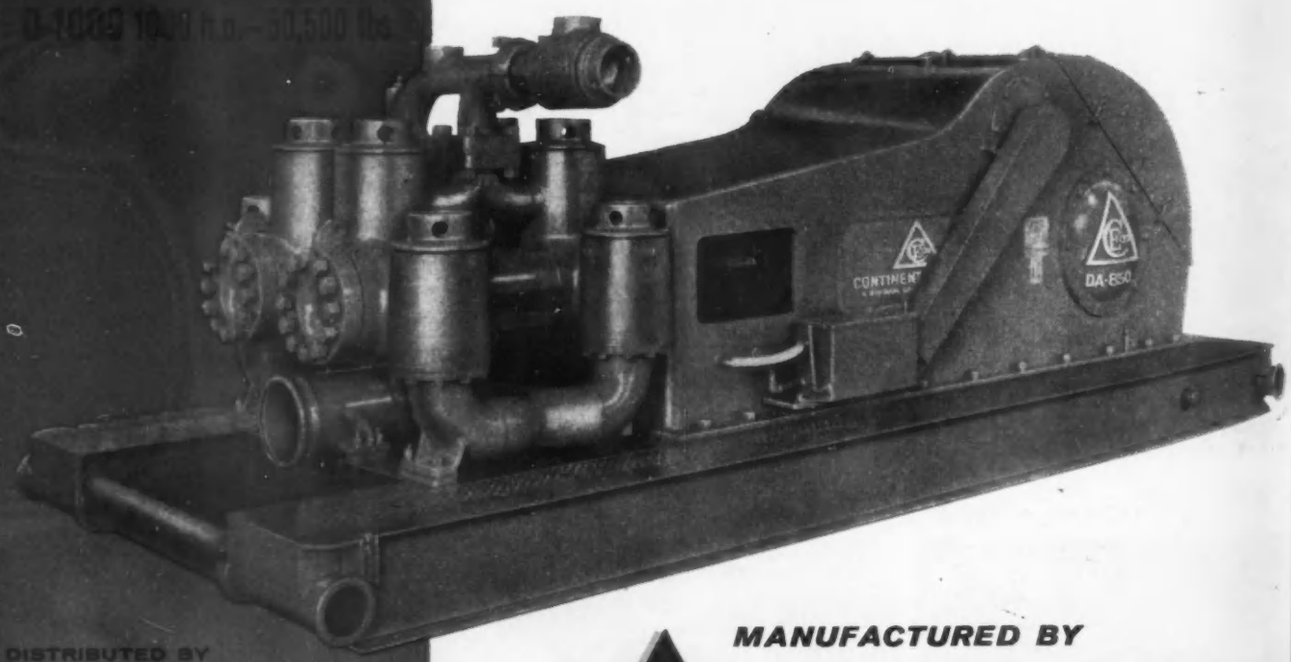
D-1000 1000 h.p.—50,500 lbs.

No *wasted* dollars here. Low weight of these pumps cuts transportation costs . . makes them easier to handle around the rig for faster spudding-in. Lightweight steel plate construction replaces bulky, heavy castings.

Maintenance downtime is greatly reduced. Daily adjustments are not necessary. Lubrication is completely automatic, and greasing is not required. Patented "exposed" liner design helps prevent liner washouts, since packing leaks can be spotted immediately . . long before damage can be or has been done.

Six models help cut initial investment by providing a range of sizes to meet all drilling conditions at the lowest possible cost.

High performance of "D" Series pumps . . proved by years of drilling in the oil fields of the world . . assures penetration at its fastest rate.



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MID-CONTINENT SUPPLY COMPANY
FORT WORTH, TEXAS

EXPORT: Mid-Continent Supply Co., Inc. 45 Rockefeller Plaza, New York 20, N. Y.

IN CALIFORNIA
CONTINENTAL-EMSCO COMPANY

MANUFACTURED BY

CONTINENTAL-EMSCO

Serving the Oil and Gas Industries ... Worldwide

CONTINENTAL-EMSCO COMPANY • A Division of The Youngstown Sheet and Tube Company
General Offices: DALLAS, TEXAS • Plants: HOUSTON • GARLAND • LOS ANGELES

SP-802

New kind of offshore project is served by Sikorsky helicopters

STEEL ISLAND will stretch for nearly a mile in the Gulf, 7 miles off Grand Isle, Louisiana, supporting world's first offshore sulphur mining plant. Sikorsky helicopters furnish quick, dependable transportation from supply points on shore.

In the Gulf of Mexico off Louisiana, a 15-tower steel island is being built to accommodate the world's first offshore sulphur mining plant. A project of Freeport Sulphur Company, the structure will stretch for nearly a mile. It includes heavy and complex mining facilities, living quarters for 250 men . . . and, of course, a heliport.

As with so many important projects involving the discovery or development of natural resources, helicopters are flying men and cargo between the operating location and its supply points. Naturally, the helicopters are Sikorskys.

Only Sikorskys have furnished heavy-payload helicopter transportation to the oil industry on regular schedules to offshore rigs and to sites in jungles and other inaccessible areas. If transportation is a problem where you want to operate, Sikorsky helicopters may provide an answer. Write for information.

SIKORSKY AIRCRAFT
STRATFORD, CONNECTICUT
One of the Divisions of United Aircraft Corporation

For more data on advertised products, use Readers' Service Cards, last page.

Co., Inc. 45 Rockefeller Plaza, New York 20, N. Y.
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SP-802

CLARK BROS. CO.
compressors and gas turbines

DRESSER DYNAMICS, INC.
advanced scientific research

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steel structures

DRESSER MANUFACTURING DIVISION—couplings

THE GUIBERSON CORPORATION
oil tools

HERMETIC SEAL TRANSFORMER CO.
electronic transformer development

IDECO, INC.
drilling rigs

GREETINGS...

Peace on Earth to Oilmen Everywhere in an industry that is just completing its first century of service to mankind in making the world a better place to live, love and work.

MERRY CHRISTMAS

LANE-WELLS COMPANY
technical oilfield services

Magcobar.
MAGNET COVE BARIUM CORP.
drilling mud

PACIFIC
PACIFIC PUMPS, INC.
pumps

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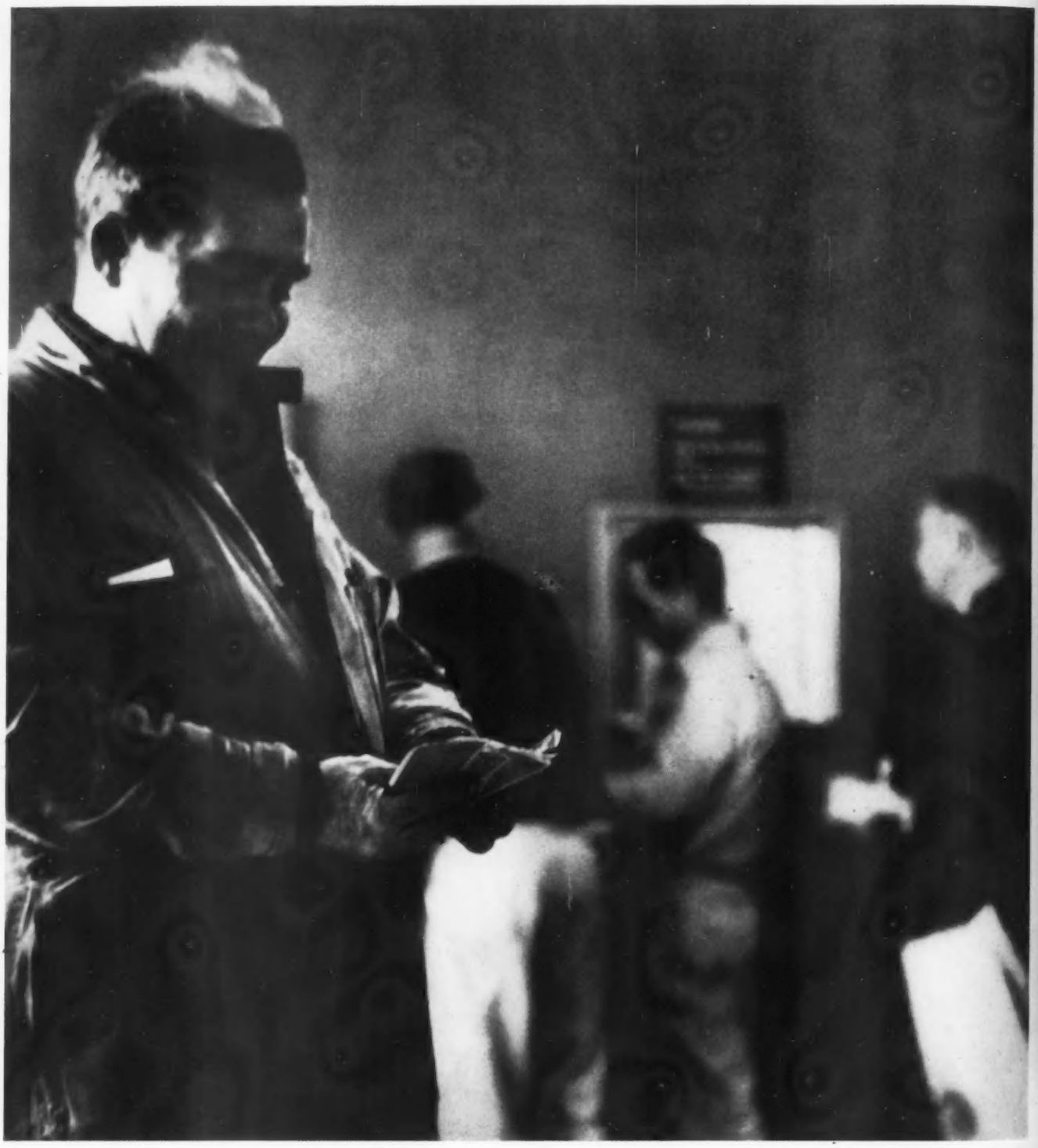
BLOWER DIVISION
blowers and meters

Security.
SECURITY ENGINEERING
DIVISION—drilling bits

SIE.
SOUTHWESTERN INDUSTRIAL
ELECTRONICS
electronic instrumentation

WELL SURVEYS
WELL SURVEYS, INC.
nuclear and electronic research

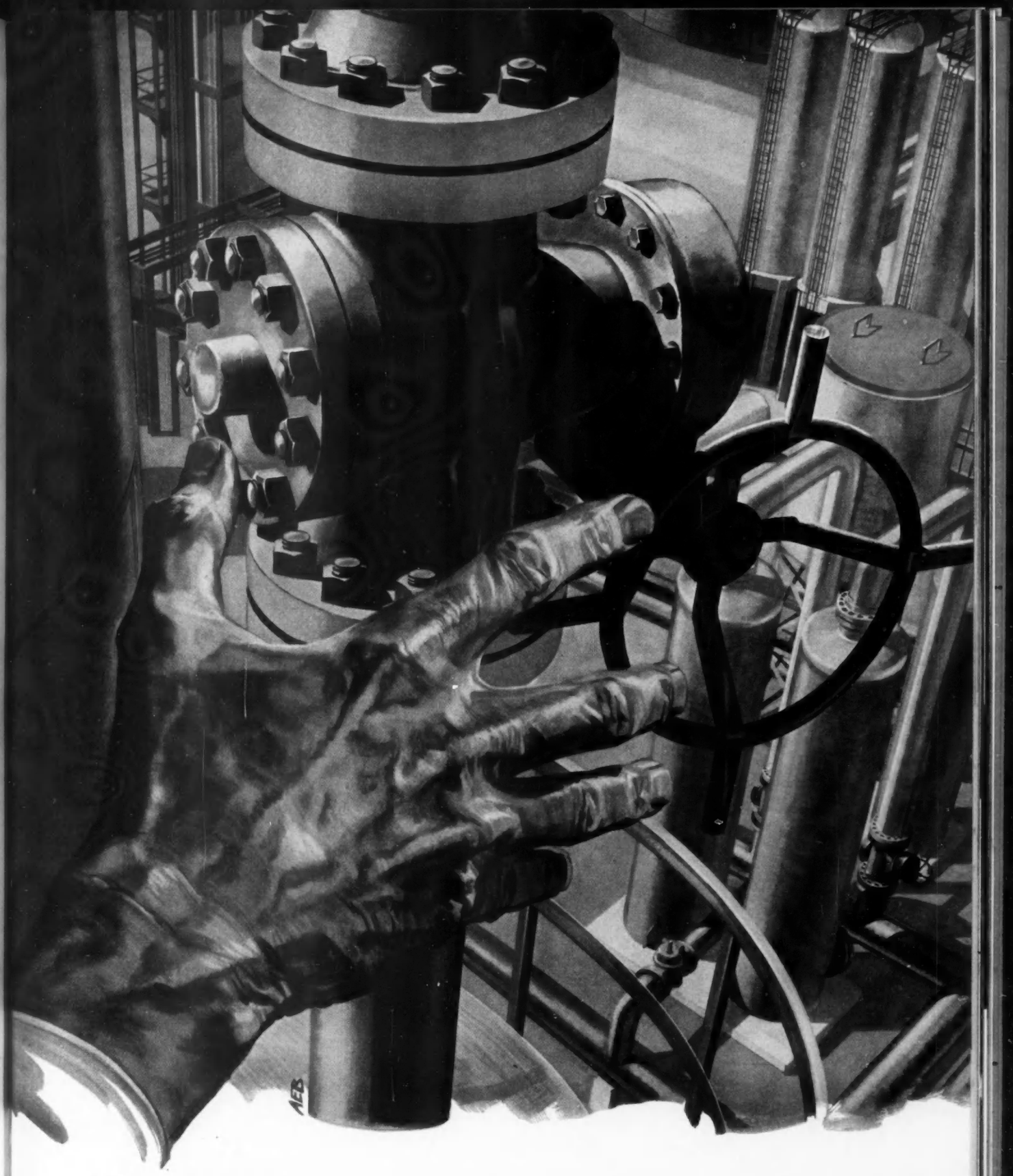


"Americans getting their weekly pay checks from the production of merchandise for foreign markets number many more than are liable to be displaced by imports from other countries. The encouragement of trade with all the countries of the free world is a basic ingredient for peace."

—Eugene Holman, Chairman of the Board, Standard Oil Company (New Jersey)

Esso

STANDARD OIL COMPANY (NEW JERSEY)
AND AFFILIATED COMPANIES



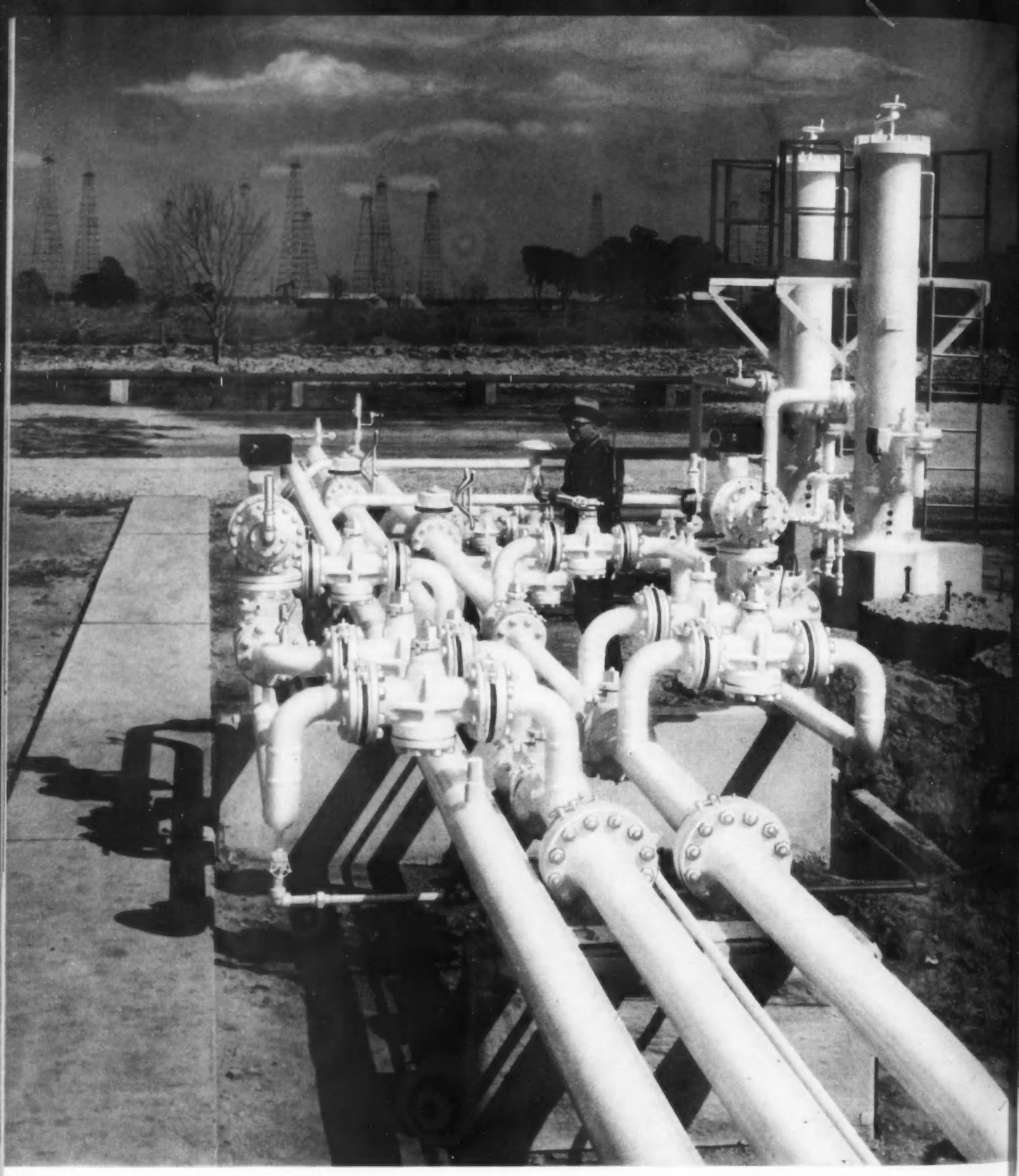
OUT BY ITSELF, this valve is too inaccessible to be pampered if it won't work. It's on services like this that you so often see Rockwell-Nordstrom lubricated plug valves. Why? Pressurized lubricant forms a *leakproof seal*, prevents wear, keeps the quarter-turn operation smooth and easy. Proved on tough services, Rockwell-Nordstrom valves naturally work better, stay in service longer and cost less to use.

Available everywhere in a *complete* range of sizes and pressures. Rockwell Manufacturing Company, Pittsburgh 8, Pa.

ROCKWELL-Nordstrom VALVES

it's **ROCKWELL**

MANUFACTURING COMPANY



HOW GOOD IS SECOND BEST?

In the oil, gas or process industries, second best is not good enough. That's why you see so many Rockwell-Nordstrom valves where only the *best* is acceptable for critical flow control. Their positive shut-off, easy operation and long-life economy just can't be equaled.

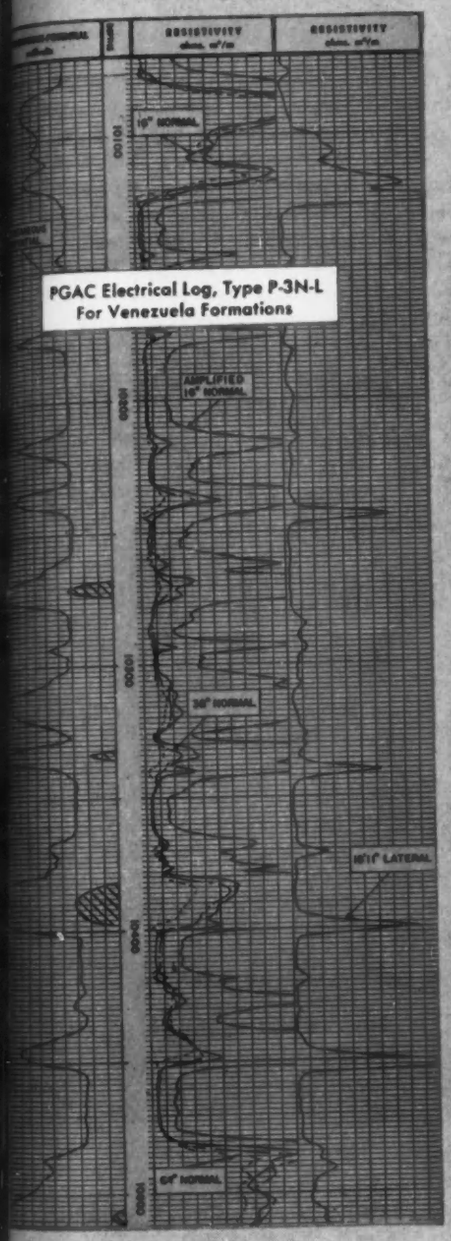
Rockwell-Nordstrom is the world's most complete line of lubricated plug valves and plug valve accessories. Rockwell Manufacturing Company, Pittsburgh 8, Pa.

ROCKWELL-Nordstrom VALVES

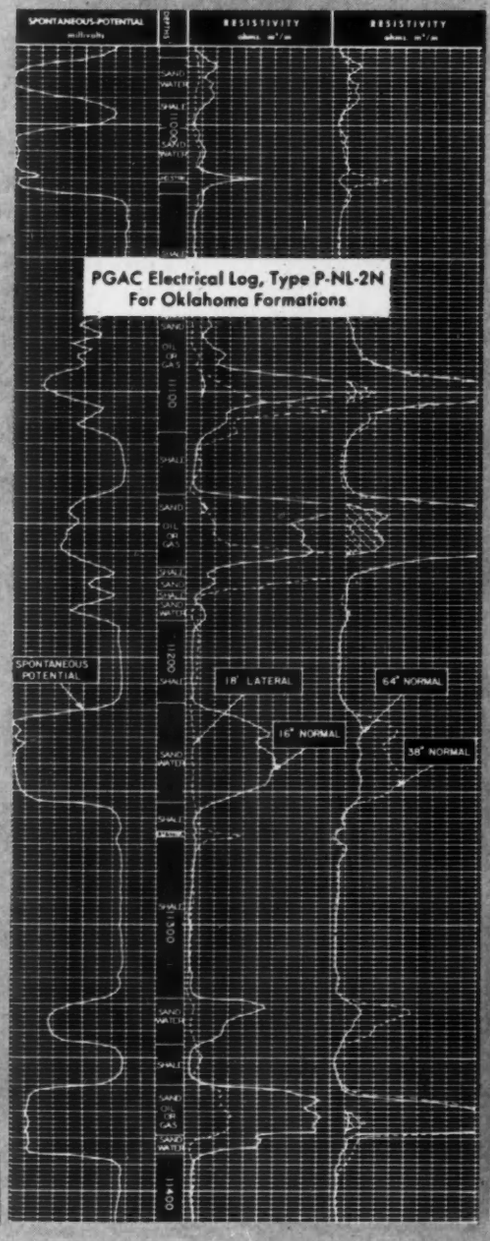
it's ROCKWELL

MANUFACTURING COMPANY

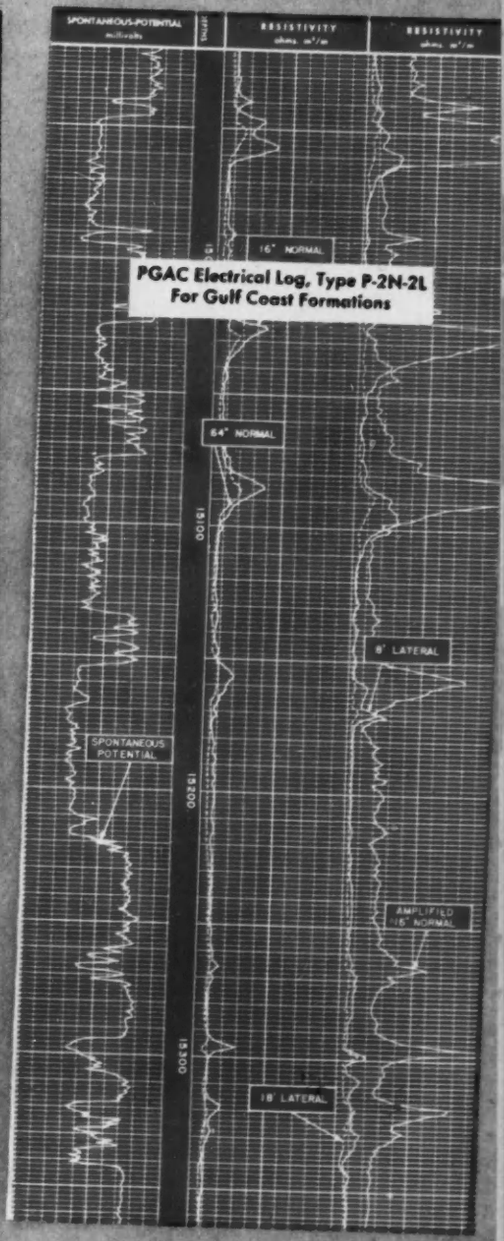
For FLEXIBILITY in Electrical Logs—
Your Best Bet Is PGAC



PGAC Electrical Log, Type P-3N-L
For Venezuela Formations



PGAC Electrical Log, Type P-NL-2N
For Oklahoma Formations



PGAC Electrical Log, Type P-2N-2L
For Gulf Coast Formations

4 RESISTIVITY CURVES and 1 S.P. = 5 Curves for more data
PLUS 1 Amplified Normal Curve placed where you want it—and all recorded simultaneously

CODE TO LOG TYPES:
P—Spontaneous Potential
N—Normal Curve
L—Lateral Curve

....for ELECTRICAL LOGS
PLAY IT SAFE--*always call* PGAC

PGAC-583

PERFORATING GUNS ATLAS CORPORATION

CHEMETRON

General Offices and Main Plant: 7730 Scott Street, Houston 21, Texas—Phone REpublic 4-1651

PGAC OIL WELL SERVICES

TEXAS: Alice — Beaumont — Bridgeport — Colorado City — Corpus Christi — Crane — Dallas — Houston — Longview — Midland — Monahans — Odessa — Pampa — Victoria — Wichita Falls. NEW MEXICO: Farmington — Hobbs.
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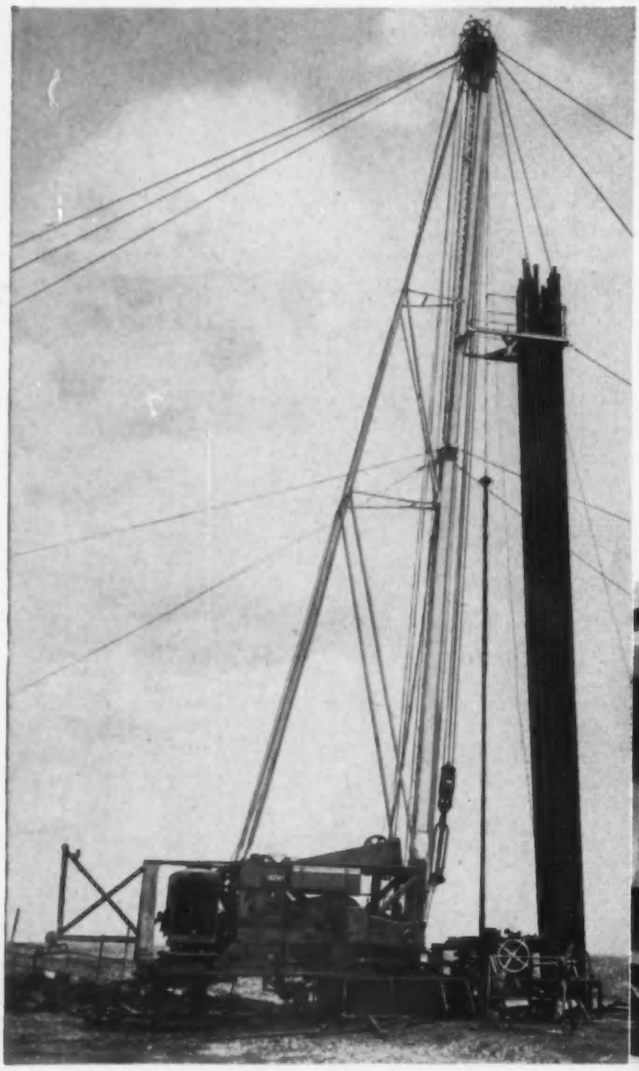
PGAC's SUBSIDIARY COMPANIES — CANADA — Perforating Guns Of Canada, Ltd. VENEZUELA and BOLIVIA — Servicios Tecnicos Atlas, C.A.
GERMANY — Atlas Deutsch-Amerikanische Olfelddienst, G.m.b.H. U.S.A. — PGAC Development Company

85-FT. SERVICING DERRICK---

"Triples our speed...puts extra production into portable, mobile 48-L"

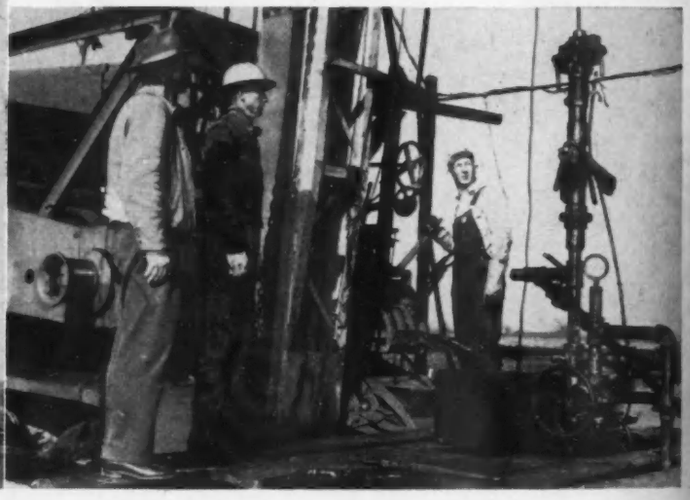
Says L. A. Wilson, of WILSON, Oklahoma



"Nobody in this area has a finer piece of equipment for servicing than this 48-L and its new servicing derrick," states Wilson, on left below, watching one of his crews service a 6,980-ft. oil and gas well near Madill, Okla. "The derrick puts a spudder-type rig in a production class it never enjoyed before, particularly as a service outfit. We used to have to pull tubing a joint at a time and lay each piece down on the ground. This unit triples our speed, and it puts that extra production into a portable, mobile rig a man can move around and set up fast.

"It's a combination which always impresses customers favorably. It assures that the job will be finished safely and on time," adds Wilson. "In the five years we've had the spudder, I believe we've replaced only a couple of brake bands and done one or two other minor repairs."

FIRST with the FINEST in Spudders



Getting a profitable edge on competition is what pleases this veteran drilling contractor most about his Bucyrus-Erie 48-L spudder equipped with 85-ft. servicing derrick.

With this rig, Wilson stacks 60 to 70-ft. tubing quickly, neatly on the platform instead of laying it on the ground in shorter length in a time-consuming operation. He can stack up to 7,300 feet of 2½-in. tubing in the derrick's convenient fingerboard rack. For moves, the power raised or lowered derrick telescopes and folds down over the rig, and the Wilson crew is off to the next job.

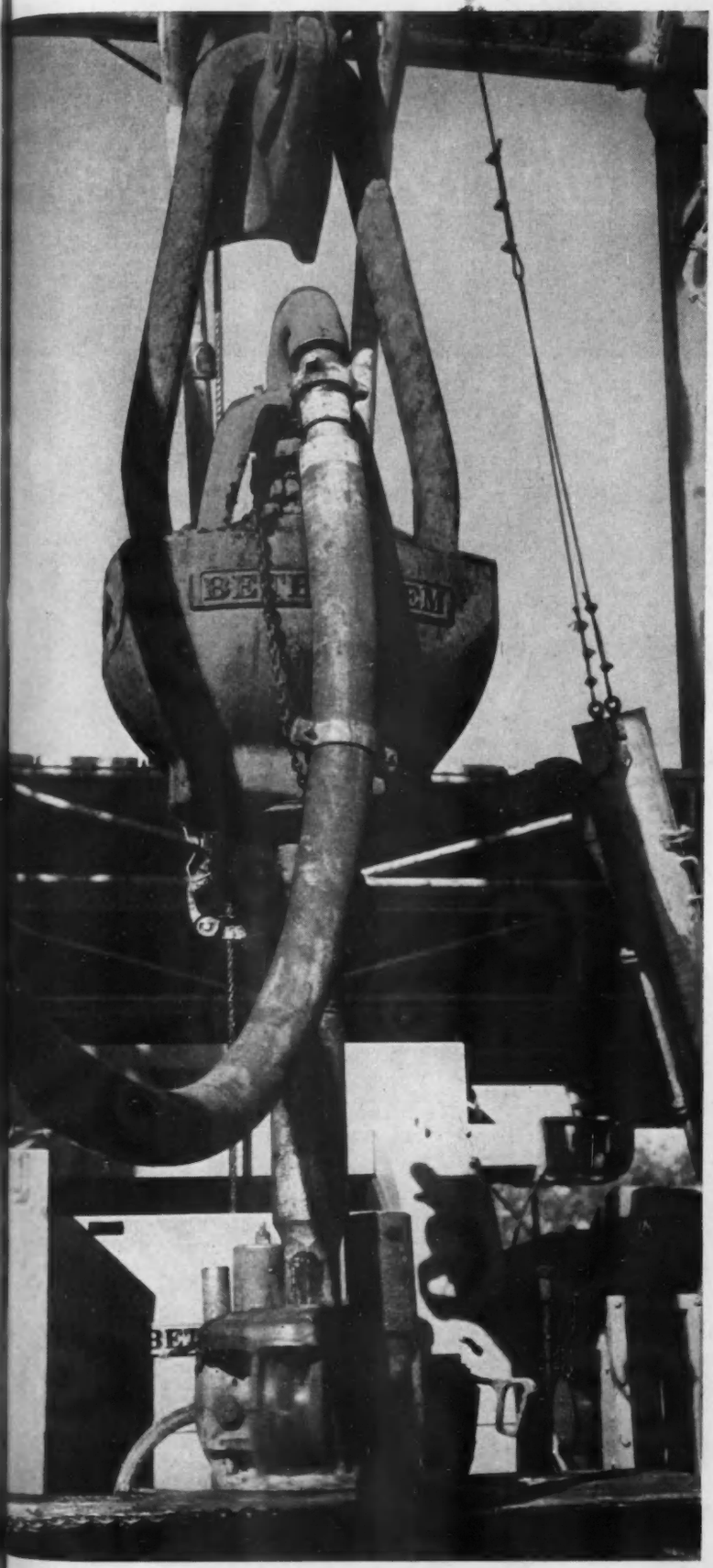
You can start now to enjoy the profitable advantage of a Bucyrus-Erie servicing derrick. Get all the facts from your nearby distributor or write us direct. Do it now! 57558

BUCYRUS ERIE

BUCYRUS-ERIE COMPANY • DRILL DIVISION, U. S. Highway 40 West, Box 324, Richmond, Indiana

PGAC's SUBSIDIARY COMPANIES — CANADA — Perforating Guns Of Canada, Ltd. VENEZUELA and BOLIVIA — Servicios Tecnicos Atlas, C.A.
GERMANY — Atlas Deutsch-Amerikanische Olfelddienst, G.m.b.H. U.S.A. — PGAC Development Company

LOOK AT THESE DEAD-LOAD CAPACITIES



Bethlehem swivels start at 100 tons; go up to 450

The smallest Bethlehem swivel has a dead-load capacity of 100 tons; the largest, 450. This in itself is good evidence of the strength, the ruggedness, that always characterize Bethlehem swivels.

Bethlehem places particular emphasis upon the main bearing, the most important working part of any swivel. More than anything else, it's the big, husky main bearing that keeps a Bethlehem swivel going where others fail.

Call or write for complete information. Our nearest office or store will gladly furnish engineering data.

Basic features of Bethlehem swivels

- Type of main bearing: tapered roller. Oil circulation induced by main bearing
- Stem-alignment bearings: radial roller
- Separate upthrust roller bearing
- Forged alloy-steel stem and subs
- Heavy one-piece body
- Double-life washpipe; can be locked either top or bottom to divide wear
- Stem protected from wear under oil seals and radial bearings by replaceable sleeves
- Forged-steel bail
- Extra-capacity oil reservoir

Model	Dead Load Capacity	Recom. Drill. Depth, 4½-in. drill pipe, 100 rpm	Hydraulic Test Pressure
BT-11	100 tons	5,000 ft	3,000 psi
BT-15	150 tons	7,500 ft	4,500 psi
BT-18	225 tons	11,250 ft	6,000 psi
BT-24	450 tons	18,000 ft	6,000 psi

BETHLEHEM SUPPLY COMPANY

General Offices: 21 E. Second St., Tulsa, Okla.
West Coast Headquarters: Los Angeles, Calif.

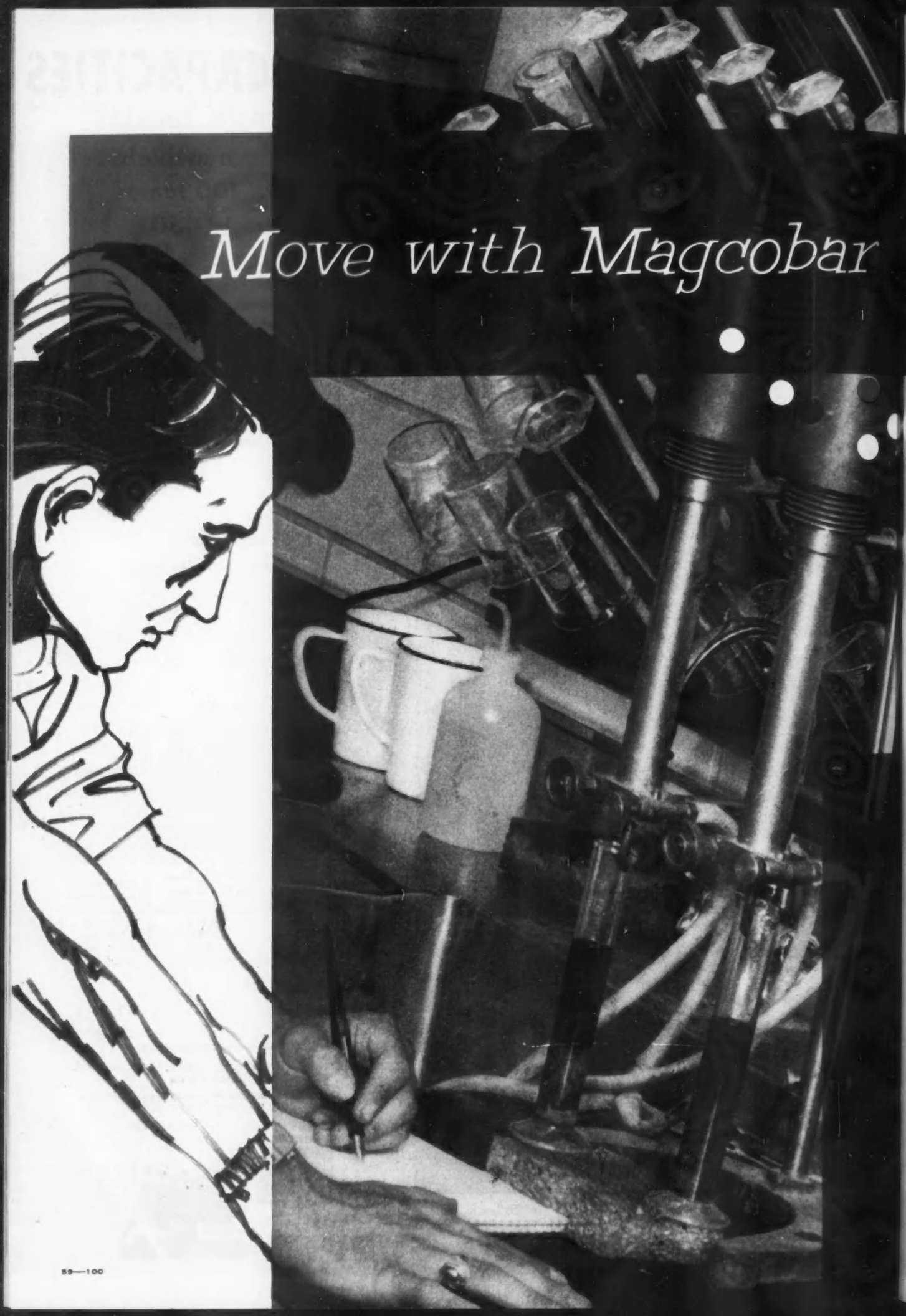
Canadian Distributor: Bethlehem Supply Company of Canada, Ltd. Calgary, Alberta, Canada

Export Office: Bethlehem Supply Company (Export Division) 25 Broadway, New York, N. Y.

BETHLEHEM STEEL

BETHLEHEM SUPPLY

BETHLEHEM SUPPLY


Move with Magcobar t
59—100

to Better Drilling

● FOR COST-CUTTING PRODUCTS

● THE KNOW-HOW TO USE THEM

There are three sound reasons why Magcobar can cut your drilling costs. First, proved excellence of products. Second, the industry's best trained mud engineers plan the mud program for your well and keep it running smoothly. Third, extensive research facilities keep bringing you the best drilling chemicals and additives for your particular problems.

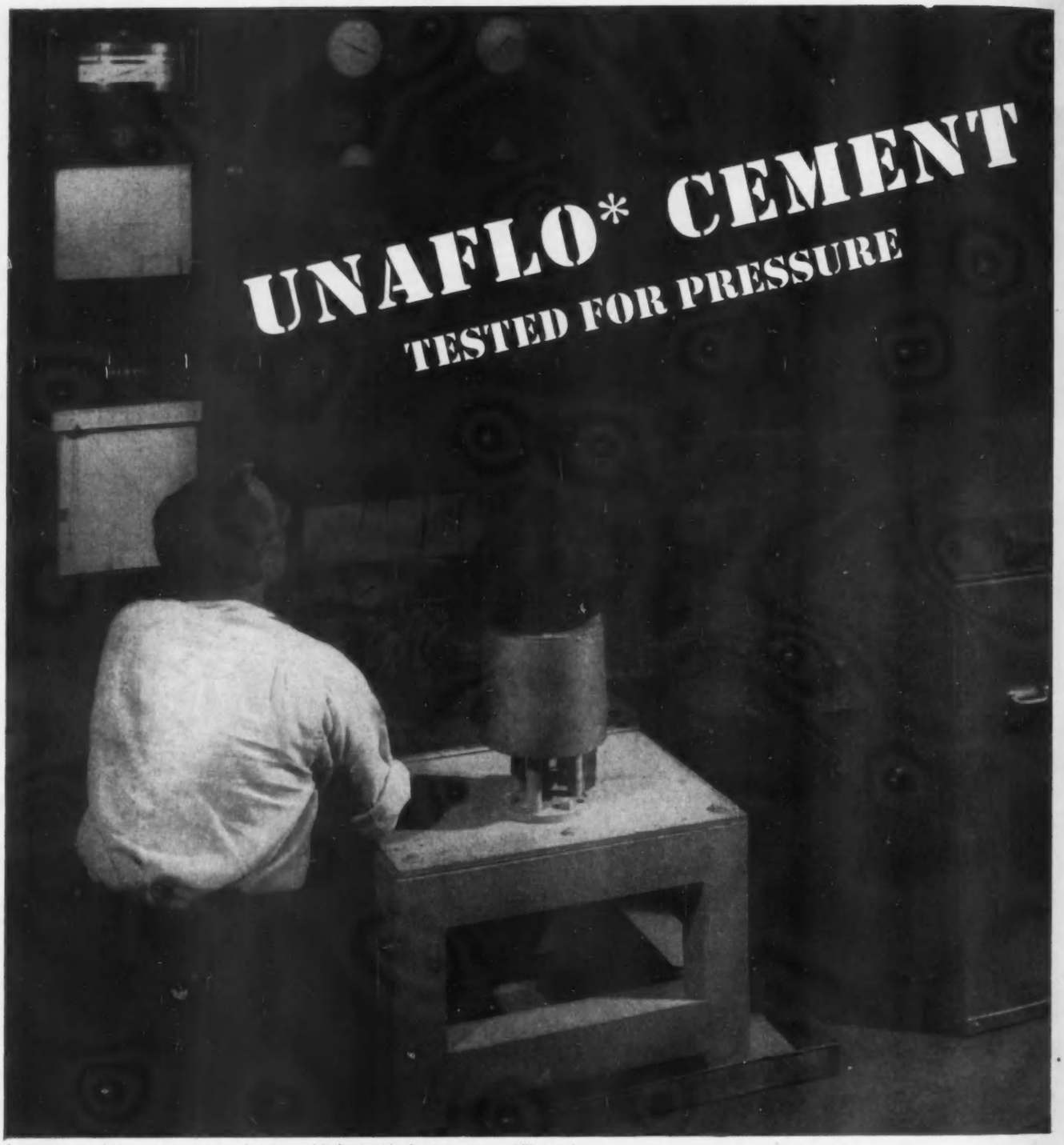
Bringing these three important reasons for Magcobar superiority to their present high level can never be the work of a day or a year by any company. Product quality is based only on careful controls and strict analyses from production to well. A mud engineer's skill is born with training in the lab—a big lab with experience—matures under a wide range of field conditions, and reaches full power in the continual mastery of new techniques, new products. And research, a word frequently sinned against, means continuing expense, continuing outlay of cash to keep on providing the drilling industry with the best products and techniques.

Save with Magcobar on your next well.

MAGNET COVE BARIUM CORPORATION

HOUSTON

Magcobar
Complete
DRILLING MUD SERVICE



Apparatus used to cure cement specimens used in heat of hydration, permeability and absorption tests. Pressure vessel in foreground simulates these well conditions: temperatures from 80° F. to 400° F. and pressures from atmospheric to 10,000 psi.

- Careful attention to product testing of UNAFLO retarded oil-well cement pays off in down-the-well dependability.
- UNAFLO slurries pump easily, and stay pumpable under high bottom-hole temperatures and pressures, giving vital extra time in case of emergencies.
- After its retarded period, UNAFLO cement hardens normally to form a strong, well-bonded structure that is watertight and resistant to sulphate waters.

For typical data tables, write: Universal Atlas, 100 Park Avenue, New York 17, N. Y.

*UNAFLO is a registered trade-mark

U-156

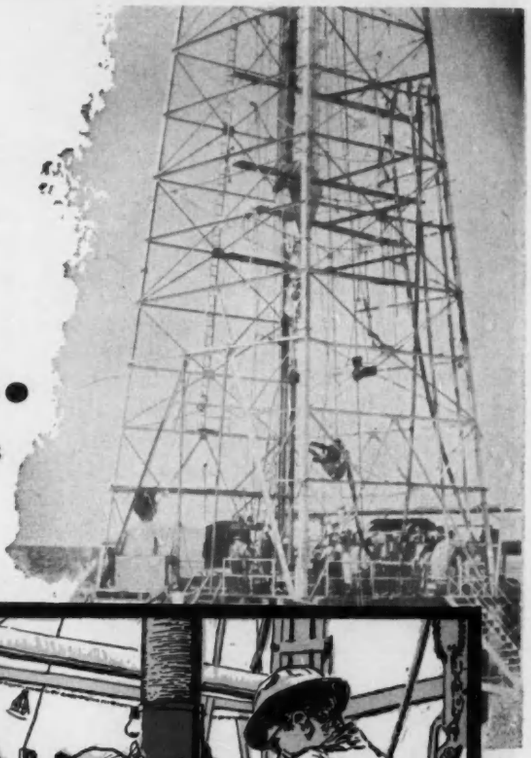
UNIVERSAL ATLAS CEMENTS

Universal Atlas Cement
Division of United States Steel

USS TRADE MARK

OFFICES: *Albany · Birmingham · Boston · Chicago · Dayton · Kansas City · Milwaukee · Minneapolis · New York · Philadelphia · Pittsburgh · St. Louis · Waco*

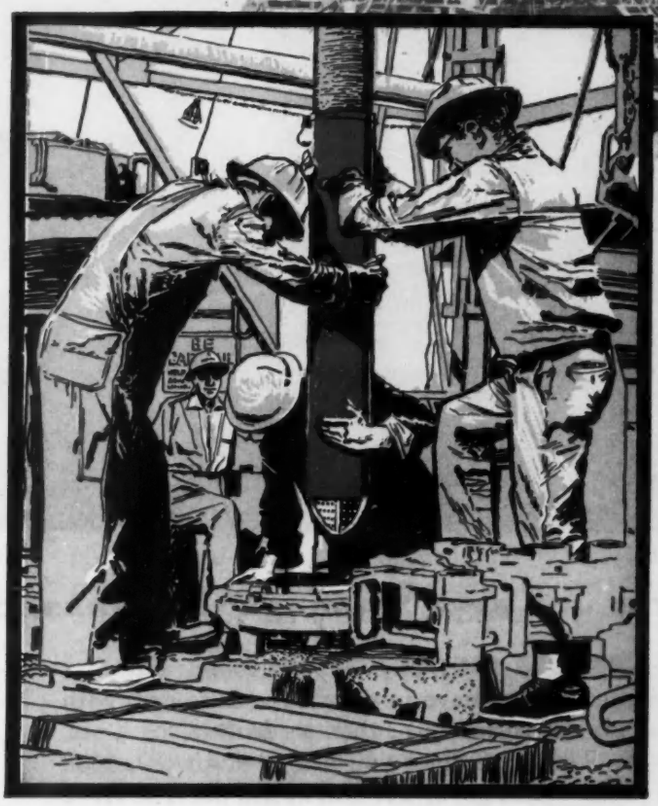
~~NEW~~ Another WORLD'S RECORD...



RECTOR TYPE "O" FILL SHOE and COLLARS HELP SET CEMENTING RECORD IN WORLD'S DEEPEST WELL

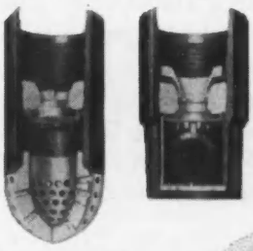
.....SAFELY!

BULLETIN: Phillips Petroleum Co. has successfully run and cemented casing to 23,000 feet in its Montgomery A No. 1 well in Pecos County, Texas, to break the world's depth record for casing and cementing previously established by the same company in its 1-EE University. Again Rector Type "OP" fill shoe and Type "O" fill collars were used to set the new record... safely!



PHILLIPS PETROLEUM CO. set two remarkable records with its world's deepest well, the 1-EE University in Pecos County, Texas, recently when it ran 22,919 feet of casing, the longest string ever run, and cemented a column 18,819 feet high in the hole, another record. And a Rector Type "OP" fill shoe with three Type "O" fill collars were used to help accomplish this amazing feat... *safely*... in a record overall time of 28 hours.

Whether your well is the world's deepest or a routine operation, the Rector Type "O" fill shoe is the *safest* you can use if there is any danger of sticking pipe. With the Rector Type "O" automatic fill shoe, you can stop running pipe and circulate the well as often and for as long as needed... and then resume running pipe with controlled orifice fill after circulating. Only Rector offers this exclusive safety feature.



Specify Rector equipment in your next cementing program. See your favorite supply store – or ask a Rector man for details.

RECTOR WELL EQUIPMENT COMPANY INC

★ MAKING THE OIL INDUSTRY SAFER

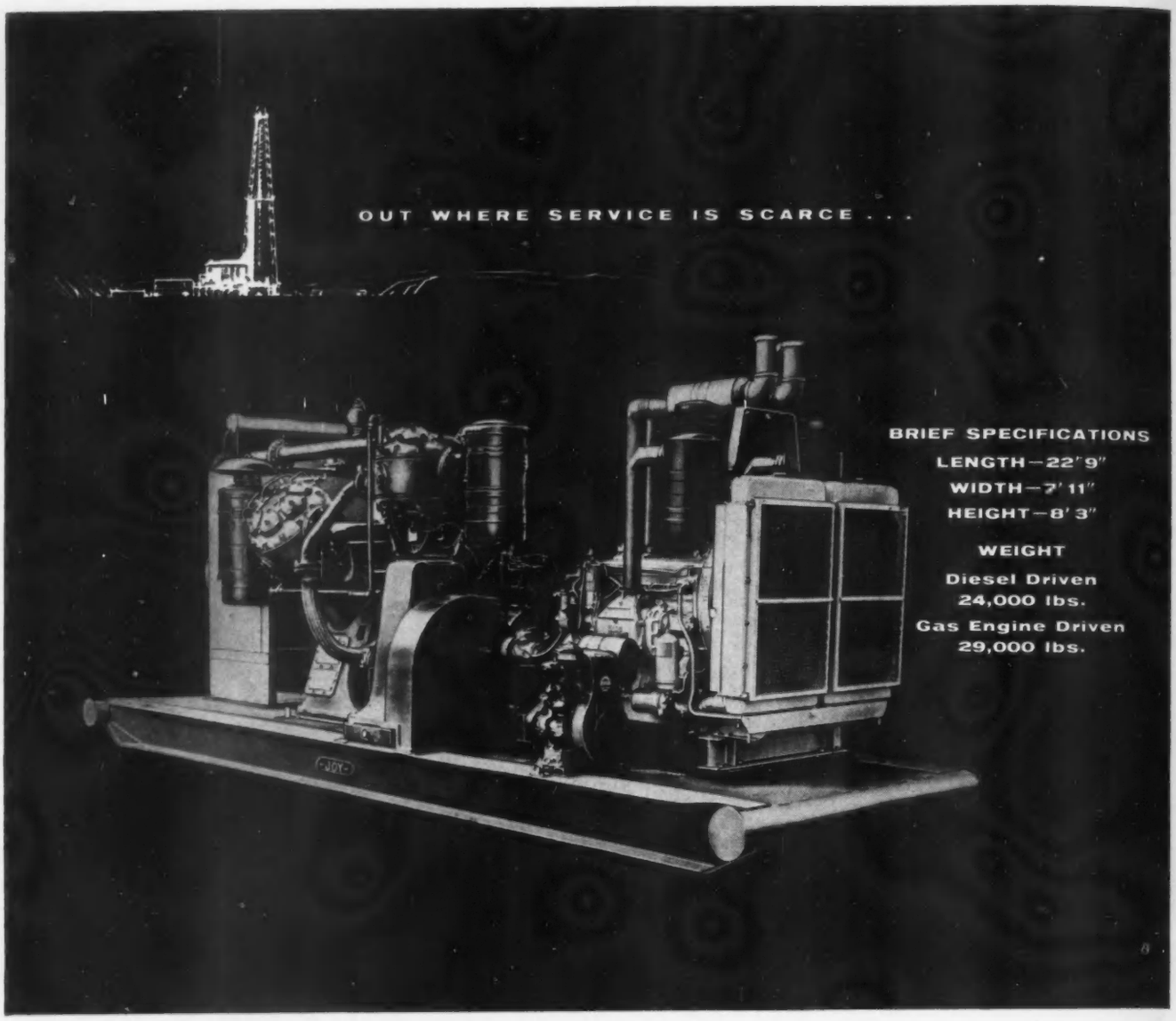
ASSOCIATION OF WELL HEAD EQUIPMENT MANUFACTURERS CERTIFIED

1100 NORTH COMMERCE ST. FORT WORTH, TEXAS

Houston Plant: 2215 Commerce St.

EXPORT REPRESENTATIVES: Continental Supply Company • Mid-Continent Supply Company • Oil Well Supply Company

For more data on advertised products, use Readers' Service Cards, last page.



THE JOY AP-2 "PACKAGE" COMPRESSOR . . . *designed* FOR AIR DRILLING

DRILLING CONTRACTORS: We found out what you had to have in a compressor to drill with air successfully . . . then we *built* it.

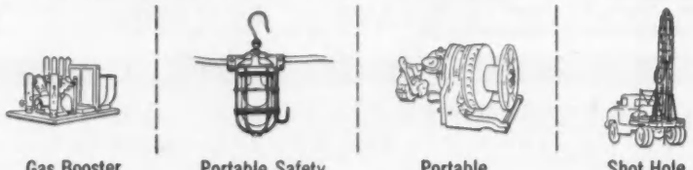
The AP-2 gives you plenty of air . . . 1056 cfm at 125 psi or 647 cfm at 250 psi. The AP-2 is rugged . . . takes all the abuse of day after day operation out in the open. And it has all the features you've asked for: REMOTE CONTROL OPERATION: regulated by lever controls at the drillers console. INSTANT PORTABILITY: mounted on a single, oil-field type skid—ready for over-the-road hauling. TRUE PACKAGE UNIT: Completely self-contained . . . always ready to run.

For real success with air drilling use a compressor *designed* for air drilling . . . the Joy AP-2. ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

WSW O-6594-171

JOY... EQUIPMENT FOR THE OIL FIELDS . . . FOR ALL INDUSTRY

WRITE FOR FREE BULLETIN 171-30



Gas Booster Compressors | Portable Safety Lighting | Portable Hoists | Shot Hole Rigs

Announcing

a great advancement in

DRILLING CONTROL *for* MEDIUM SIZED RIGS

The MARTIN-DECKER

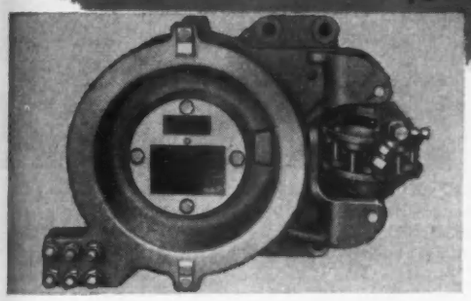
LOW COST

TYPE "FS" WEIGHT INDICATOR

NOW equipped with the Famous

* SENSATER

for greater accuracy and sensitivity



MARTIN-DECKER *is now offering the Type "FS" Weight Indicator with the famous Sensater replacing the piston as the sensing element. This gives the "FS" all the advantages of its bigger brothers—the "E" and "D" Weight Indicators.*

THE SENSATER realizes every weight change no matter how small and relays it instantly to the Indicator mounted conveniently in front of the driller. At medium depths small weight changes are very important and must be known for best operation. It is in the medium range that competition is extremely strong and footage rates cut to the barest margin of profit. A rig operator cannot afford any unnecessary loss of time and must make the best use of all drilling time. The Type "FS" is the best insurance against lost time due to fishing jobs, giving him quick and better recovery. The sensitivity and accuracy in this instrument will give the best use of all drill collars run . . . and faster, better hole.

The anchor installation provides a quick, easy method of slipping the line and because the Sensater is an integral part of the anchor there is no need to move the pressure transformer during the operation — thus preventing one of the major causes of Weight Indicator damage.

The indicator has a net weight on bit pointer and dial that is extremely helpful to the driller in maintaining a constant bit weight. Experience has shown this instrument to be accurate and dependable for many years of trouble-free operation.

THE ANCHOR—The Type "FS" Wire Line Anchor is manufactured by the National Supply Company. It is similar to the "E" and "D" anchors with the exception of being lighter, smaller and designed for side mounting. It provides a simple, convenient method of slipping the line and does not require the removal of the Sensater.

THE SENSATER — The Sensater sensing element in the "FS" is a smaller edition of the one incorporated in the "E" and "D" instruments and offers all the advantages of the larger cell. This new addition to the "FS" instrument makes it even more attractive to the operator who desires a sensitive, accurate weight indication at low cost.

THE GAUGE — The Type "FS" gauge is equipped with a total load pointer and a four-to-one vernier pointer for extra sensitivity. There are also two dials: the inner dial, reading in pounds or kilos, for the total load and the outer dial is adjustable to enable the operator to read the weight on the bit or the net pull on the pipe when fishing or in a tight hole.

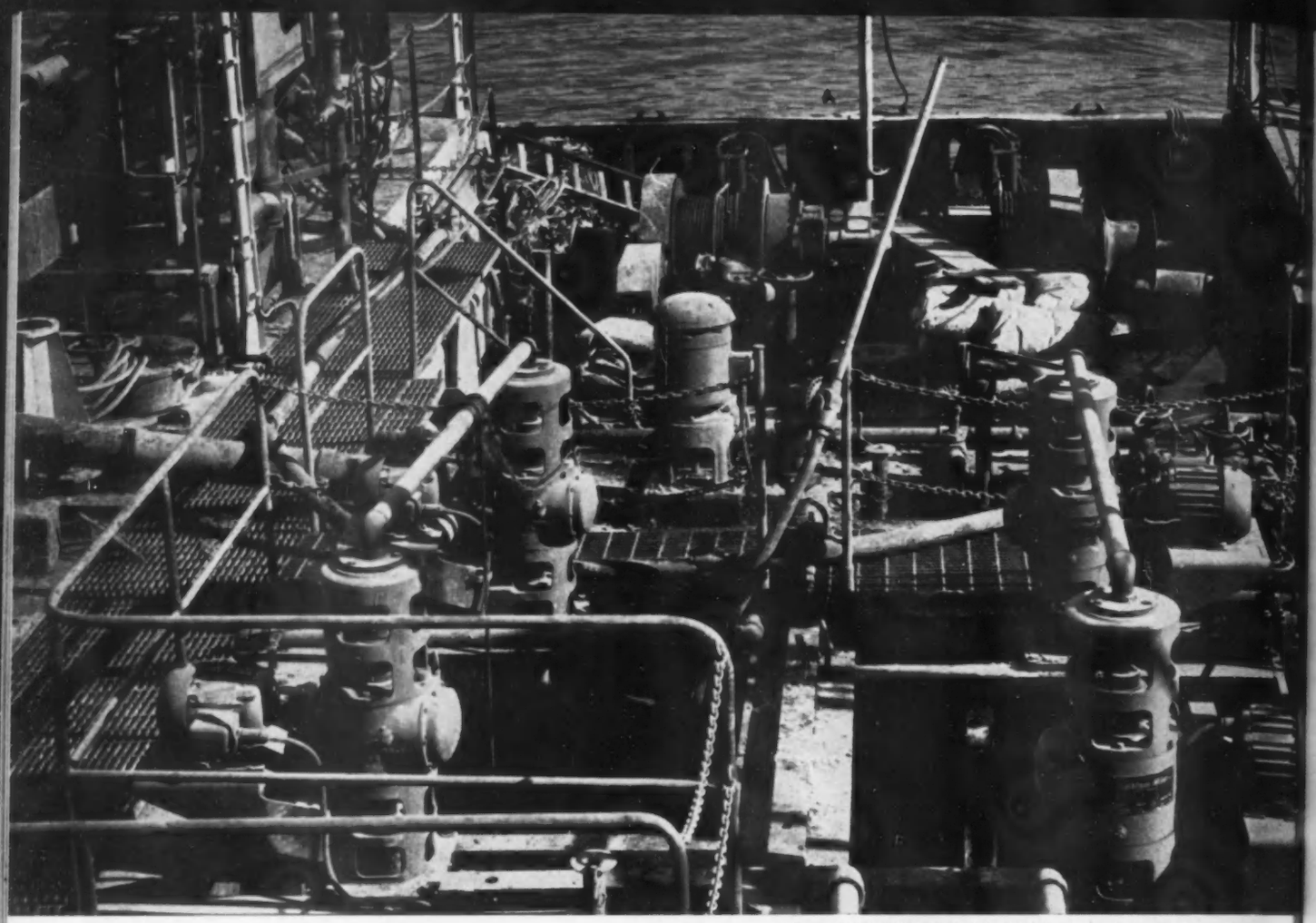
***SENSATER—Extra Accurate—Extra Sensitive—Extra Dependable**

Write For Descriptive Literature

MARTIN-DECKER CORP.

HOME OF THE WEIGHT INDICATOR — LONG BEACH, CALIFORNIA

Martin-Decker Weight Indicators and National Wire Line Anchors are sold through the Reed Roller Bit Company, the National Supply Company, and other recognized supply houses, as well as by the Martin-Decker Corporation, 3431 Cherry Avenue, Long Beach 7, Calif.



FAST MUD CONTROL IS EASY aboard the Rincon. Four turbine-type LIGHTNIN Mud Mixers, foreground, keep mud uniform. LIGHTNIN Flash Mixer, just left of center, incorporates weight and gel additions as fast as needed and without clogging.

Here's why mud control is no problem *on Richfield's new deep-water rig*

Hop aboard one of the first ocean-going drilling rigs—Richfield Oil Corporation's 600-ton converted LSM Rincon.

A quick glance tells you nothing has been spared to make this pioneer vessel safe, comfortable, efficient as it probes the bottom in waters up to 300 feet deep off the California coast.

Stroll over to the mud tanks and see how the Rincon's drilling crew keeps mud in top condition—ready for instant use.

Uniform mud . . . always

Above the mud tanks you see four electrically powered LIGHTNIN Mud Mixers. From each mixer hangs a shaft with a big turbine at its lower end.

These turbines churn the mud powerfully, creating strong, smooth flow and interchange throughout the tank. In constant motion, mud cannot settle out; *stays fully uniform* at the desired weight and viscosity.

Heavier mud . . . in seconds

When the driller needs heavier mud, he gets it—*in seconds.* Weight and gel additions are fed to the tanks through a LIGHTNIN Flash Mixer mounted in an open-bottom well. A high-speed propeller on this mixer instantly breaks all lumps and disperses weight and gel finely in the mud.

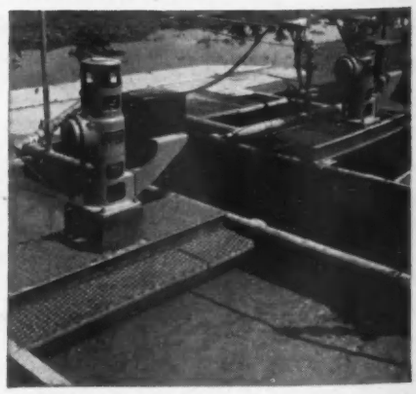
Then the big LIGHTNIN turbines swiftly mix in all additions—equalize the mud *as fast as new ingredients can be fed to it.*

Lower-cost drilling

You get faster, safer, more productive drilling with mixers like these on *your* rigs. Fewer stops; no long waits for heavier mud; *surer protection* against blowouts.

Best of all, you cut drilling cost *with* LIGHTNINS *in your mud tanks. Save the entire cost and upkeep of an extra stand-by mud pump. You need only* one *stand-by pump when you mix with* LIGHTNINS.

See for yourself what amazingly fast mud control you get with LIGHTNINS—at less than your present cost. Your LIGHTNIN Mixer representative will gladly arrange a visit to a LIGHTNIN-equipped rig near you. Call him today (he's listed in Composite Catalog). Or write us direct.



MUD REALLY MOVES. On top, underneath, all through the tank, it keeps equalizing—can't settle out. Powerful flow gives you *instant* control of mud weight and viscosity.

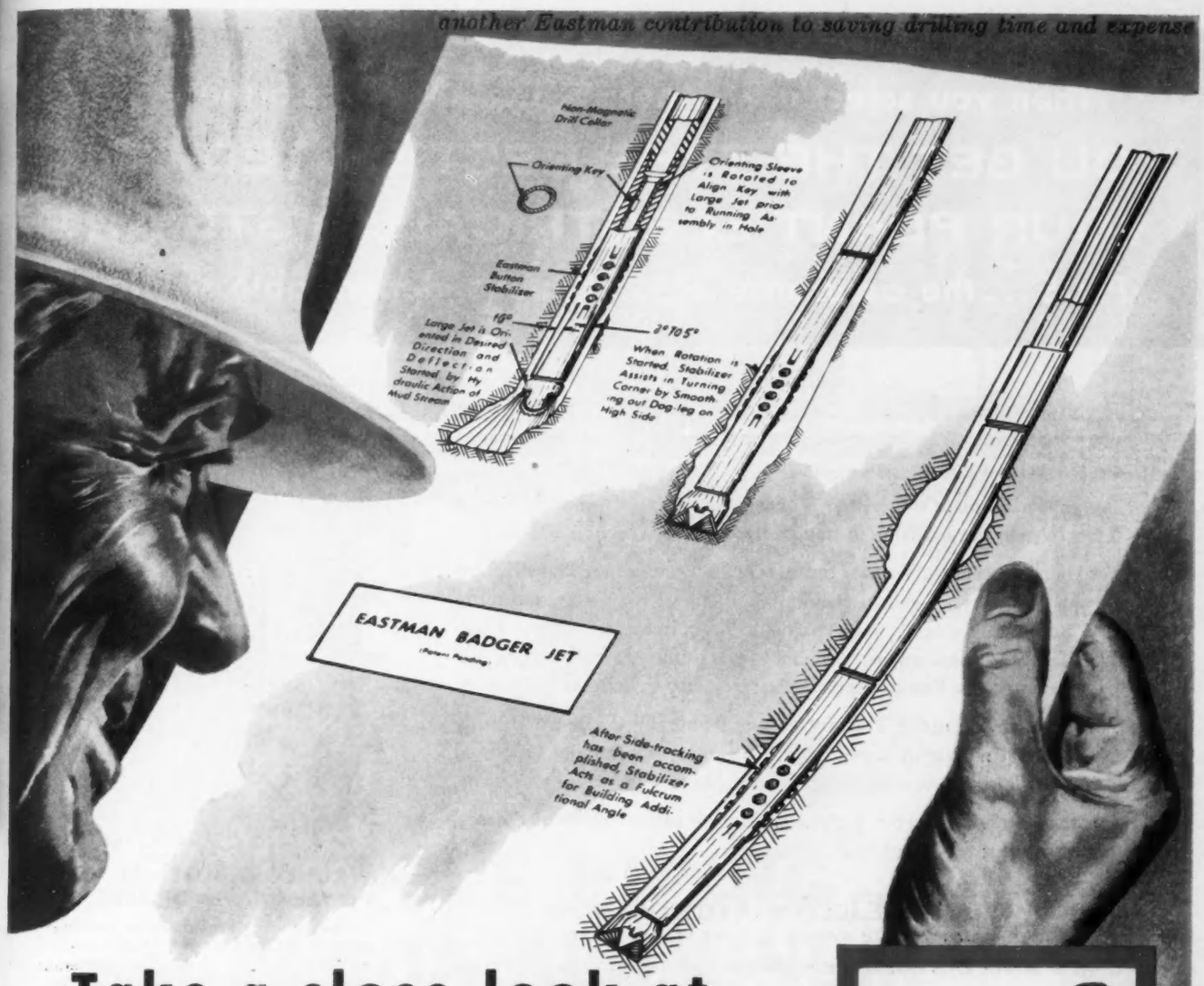
"Lightnin® Mixers"

MIXCO fluid mixing specialists

MIXING EQUIPMENT Co., Inc., 197-n Mt. Read Blvd., Rochester 3, N.Y.

In Canada: Greey Mixing Equipment, Ltd., 100 Miranda Avenue, Toronto 19, Ont.

another Eastman contribution to saving drilling time and expense


Non-Magnetic Drill Collar
Orienting Key
Orienting Sleeve is Rotated to Align Key with Large Jet prior to Running Assembly in Hole
Eastman Button Stabilizer
18°
3°10.5°
Large Jet is Oriented in Desired Direction and Deflection Started by Hydraulic Action of Mud Stream
When Rotation is Started, Stabilizer Assists in Turning Corner by Smoothing out Dog-leg on High Side
EASTMAN BADGER JET
(Patent Pending)
After Side-tracking has been accomplished, Stabilizer Acts as a Fulcrum for Building Additional Angle

Take a close look at this Eastman exclusive

. . . See how Eastman's new Button Stabilizer and Badger Jet Combination Solve Deflecting Problems

The EASTCO Button Stabilizer, easiest to field dress of all quick change stabilizers plus the fast drilling EASTCO Badger Jet provides an assembly that is unique in its design and efficiency for directional drilling in soft formations.

It drills a full gage hole; can be reoriented at any time with EASTCO Universal Single Shot B.H.O. instrument without coming out of hole; insures minimum annular restriction for maximum jet action and penetration; introduces hole curvature at uniform rate, minimizing key-seat problems. This is another example of Eastman's development program . . .

. . . dedicated to progress through advanced engineering . . . research . . . and service to the Petroleum Industry.

EASTMAN

EASTMAN OIL WELL SURVEY COMPANY
LONG BEACH • DENVER • HOUSTON • CALGARY

For Export Write
EASTMAN INTERNATIONAL DIVISION
P. O. BOX 1500, DENVER 1, COLORADO, U. S. A.

DIRECTIONAL DRILLING • OIL WELL SURVEYING • SIDETRACKING

When you select a Wagner Wagner Transformer...

YOU GET THE TYPE BEST SUITED FOR YOUR PLANT ELECTRICAL SYSTEM...

PLUS... the assurance of continuous, dependable service!

If you are planning a new plant distribution system... modernizing your present one... or adding to its capacity to meet increasing demands for power... it will pay you to specify Wagner Transformers.

For your main plant substation, Wagner Liquid Filled Industrial Power Transformers are available in standardized ratings through 10,000 kva.

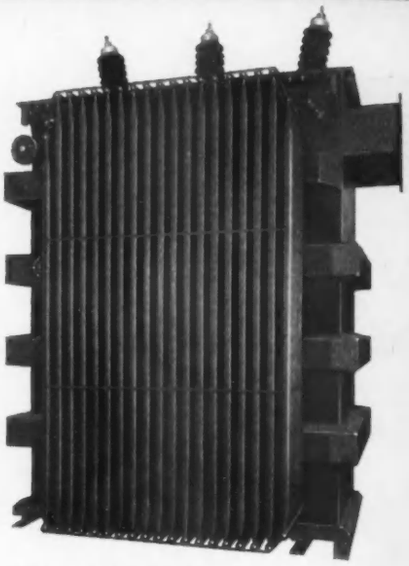
For your load centers, Wagner can supply Unit Substation Transformers in any of the types shown below, furnished with suitable incoming line sections, to meet your particular requirements. These PRE-DESIGNED transformers will save you time and save you job engineering costs. You can specify the secondary switchgear you prefer.

All Wagner Industrial Transformers are liberally designed, sturdily constructed, thoroughly tested and able to meet the heaviest industrial demands. They assure continuous dependable power for years to come.

For expert advice on your present and future plant transformer needs, call or write the Wagner branch near you.

Wagner Electric Corporation
6457 PLYMOUTH AVENUE, ST. LOUIS 14, MO., U.S.A.

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

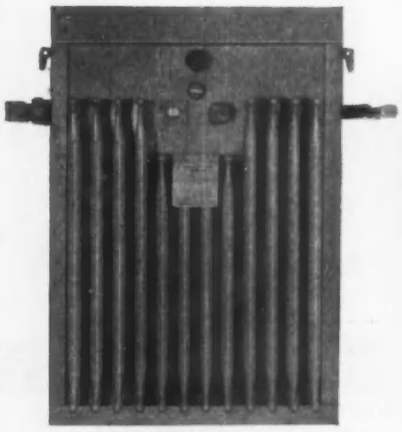


WAGNER INDUSTRIAL POWER TRANSFORMERS

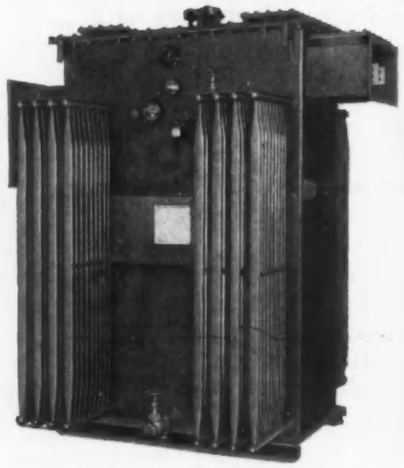
Oil-filled, for outdoor installation, available through 10,000 kva, 67 KV and below. Noflamol filled, for explosive atmospheres, available through 7,500 kva, 15 KV and below.

Wagner **UNIT SUBSTATION TRANSFORMERS**

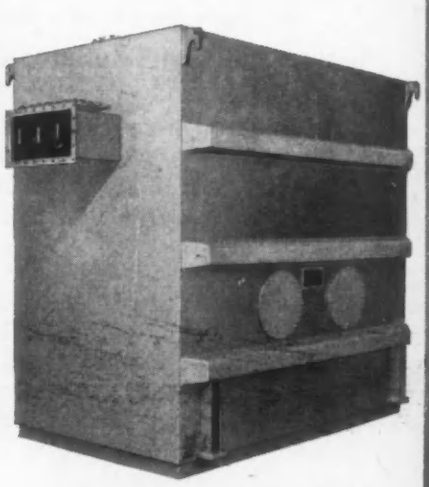
112½ to 2000 Kva—three phase, 60 cycles, 15 KV and below



NOFLAMOL Non-inflammable liquid-filled. For indoor or outdoor installation, where explosive liquids or gases are present. The close-coupled design illustrated fits flush against switchgear enclosures. Throat connected designs are also available. 55°C rise, self-cooled or forced-air cooled.



OIL-FILLED Generally installed outdoors. Can be used indoors in fireproof vaults. Outdoor transformers can be connected to indoor switchgear using weather-proof bus-duct. 55°C rise, self-cooled or forced-air cooled.



SEALED DRY-TYPE Suitable for indoor or outdoor use, completely fireproof, easy to clean and maintain. Sealed tank is filled with nitrogen under low pressure. Insulated for 150°C rise, self-cooled.

WT58-16A.

PORTABLE PIPING of ALCOA ALUMINUM

for water supply systems · gathering systems · gas lines · tank battery piping · vent lines

When your piping services call for lines that must be installed or moved frequently, portable piping of ALCOA® Aluminum is your best bet. Here's why:

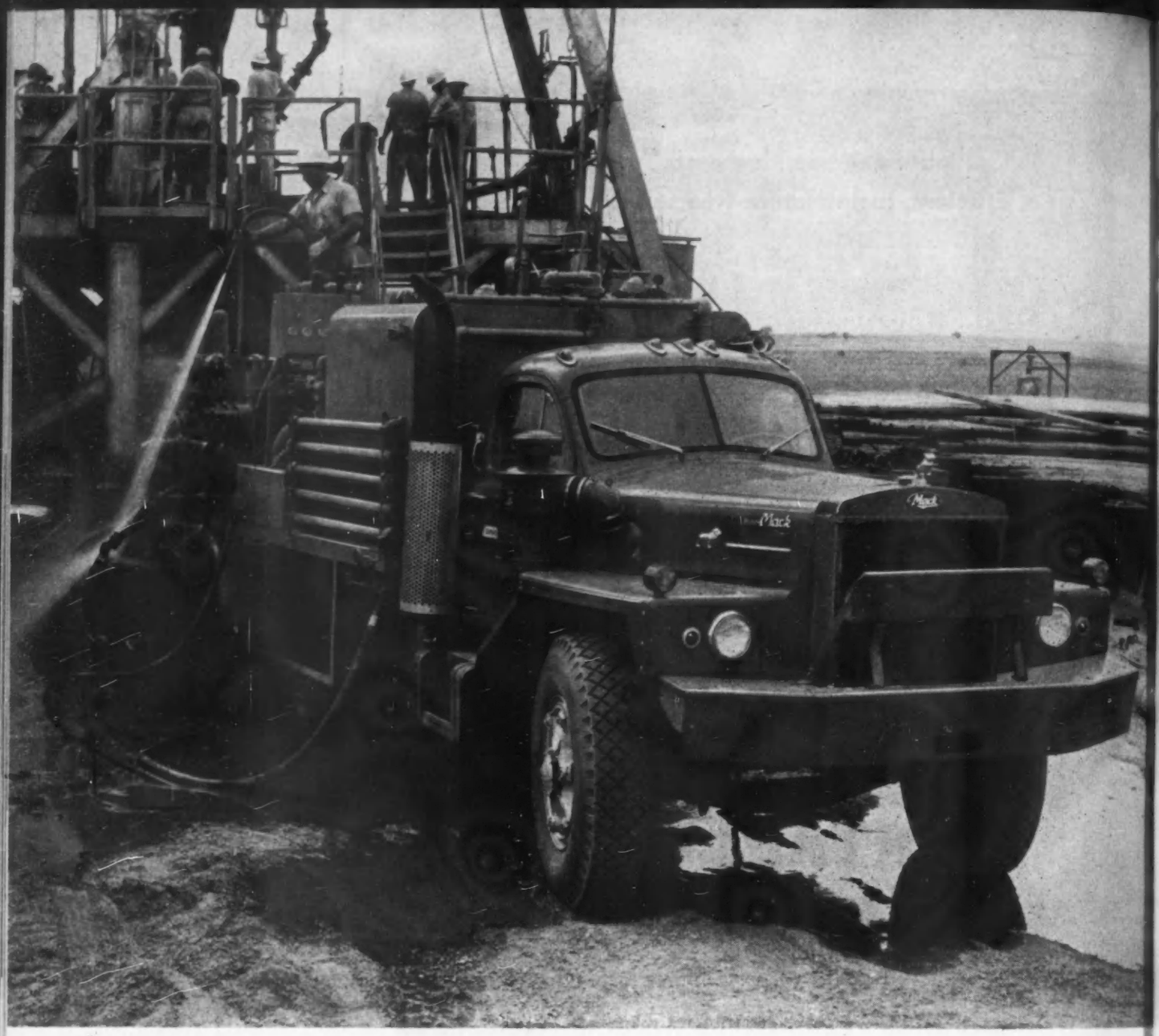
It's portable—More aluminum pipe can be carried per truck. Fewer trucks are needed for every job. Each workman easily can handle several standard lengths of aluminum pipe at one time. Large quantities of pipe can be laid by small crews in a minimum number of man-hours.

It's economical—Low labor and handling costs, added to its long service life, make ALCOA Aluminum Pipe less expensive than other piping on an installed cost-per-foot basis.

It's strong and durable—Thin walled ALCOA Aluminum Pipe has very good mechanical properties. Properly used, it will handle adequately most pressures encountered in temporary lines. It provides good resistance to mechanical damage. And the excellent natural corrosion resistance of aluminum eliminates costly maintenance and replacement under severely corrosive operating conditions.

ALCOA Aluminum Pipe and quick couplings of aluminum are available through most major oil field supply companies. You'll find the one nearest you listed in the Yellow Pages of your telephone directory. Your local distributor can furnish you with detailed literature containing complete specification data on ALCOA Aluminum Pipe. Or, you can obtain that literature by writing ALUMINUM COMPANY OF AMERICA, 920-M Alcoa Building, Pittsburgh 19, Pa.

For more data on advertised products, use Readers' Service Cards, last page.



No need to tell you...

You need a truck that's suited exactly to the heavy-duty hauling demands put upon your equipment. That's why so many operators like you depend on their Macks for the utmost in available power, minimum down time, ease of maintenance and maximum reliability.

Want a quick reason? No other truck manufacturer makes so many of its components, that work together like a top-notch derrick crew. For instance:

MACK-BUILT ENGINES—gasoline or diesel Thermodynes®. Champions all for long life, dependability and fuel economy.

MACK-BUILT TRANSMISSIONS—up to 20 speeds. Remember that Mack transmissions are built to accommodate power takeoff units necessary for oil-field work.

MACK-BUILT BOGIES—Mack alone builds its own tandem rear ends. Mack Balanced Bogie with Power Divider provides power to the wheels with maximum traction—an important factor in your rigorous operation.

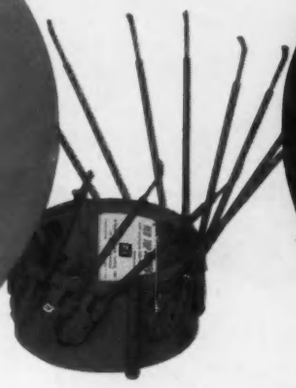
You're short on time, sure . . . but it will only take a minute to call your nearest Mack branch or distributor and ask him to verify these claims. He'll give you the names of Mack users in your own area who can tell you their experience with Macks. Mack Trucks, Inc., Plainfield, New Jersey. In Canada: Mack Trucks of Canada, Ltd.

MACK
first name for
TRUCKS

THE NEXT TIME YOU CEMENT, REMEMBER...

BJ MEANS A BETTER JOB

SCRATCH



with

BJ RED TOP SCRATCHERS

The BJ Red Top Scratcher is scientifically designed to give you better scratching without damage to the mud cake on the way down—and to maintain its effectiveness throughout the operation. Each of the exclusive double-spring, coil-flex fingers has a cluster of 10 straight wires—to spread the scratching area—encased in a tight coil spring which gives it a positive bounce-back. The Byron Jackson Red Top Scratcher features a clamp-on design that lets you put it on in a hurry. It comes in standard sizes to fit all API casing OD's.

CENTER

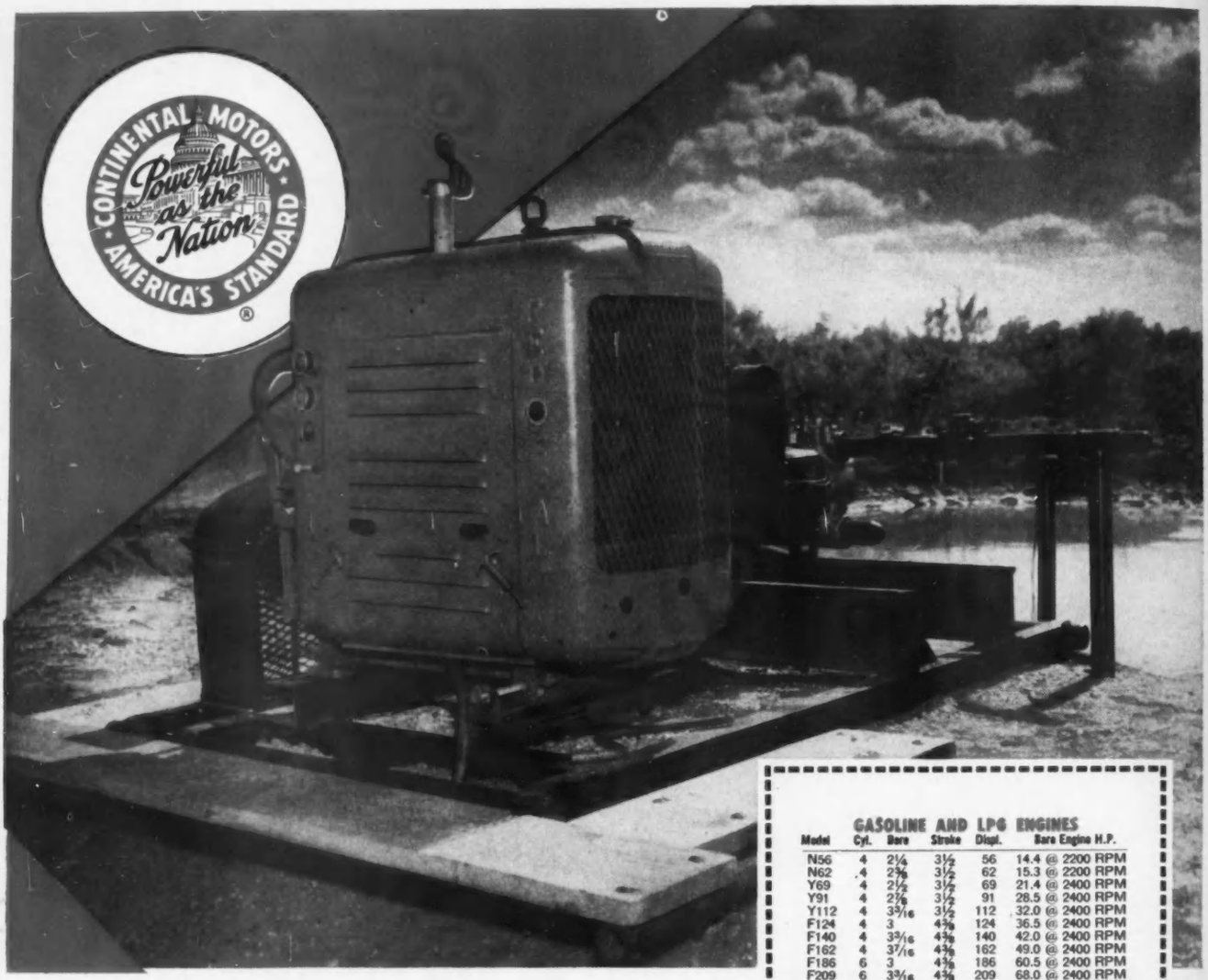
with

BJ RED TOP CENTRALIZERS

The BJ Red Top Centralizer is the result of close collaboration between Byron Jackson and the Spring Division and the Research Center of Borg-Warner. Its unique pre-stressed springs stay in place by their own force, with no welds to fail and no rivets to pop. Pre-stressing also assures you more resiliency and greater centering power within a slim overall design. Comes in all standard sizes. Clamp-on design.
BJ Centralizers and Scratchers are sold through all recognized supply stores—or see your Byron Jackson field service man or the cementing experts of BJ Service, Inc.

Byron Jackson Tools, Inc.
A Borg-Warner Subsidiary
P. O. Box 2017A, Terminal Annex
Los Angeles 54, California

WATCH BJ FOR THE NEWEST



CONTINENTAL RED SEALS
Find Ready Acceptance in the Oil Fields

The ever-widening acceptance of Continental Red Seal engines in all types of oil field operations is attributed in great part to specialization—in Continental's long-standing policy of engineering each model precisely to the job to be done. Each and every model is the product of 56 years' engine-building experience. The industrial series comprises 57 different basic models—from 14 to 237 horsepower and they are backed by parts and service from coast to coast. Visit your nearest oil field supply store or write the factory for information.

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Continental Motors Corporation
MUSKEGON • MICHIGAN

GASOLINE AND LPG ENGINES

Model	Cyl.	Bore	Stroke	Displ.	Bare Engine H.P.
N56	4	2¼	3½	56	14.4 @ 2200 RPM
N62	4	2⅜	3½	62	15.3 @ 2200 RPM
Y69	4	2½	3½	69	21.4 @ 2400 RPM
Y91	4	2⅞	3½	91	28.5 @ 2400 RPM
Y112	4	3 5/16	3½	112	32.0 @ 2400 RPM
F124	4	3	4⅜	124	36.5 @ 2400 RPM
F140	4	3 5/16	4⅜	140	42.0 @ 2400 RPM
F162	4	3 7/16	4⅜	162	49.0 @ 2400 RPM
F186	6	3	4⅜	186	60.5 @ 2400 RPM
F209	6	3 5/16	4⅜	209	68.0 @ 2400 RPM
F226	6	3 7/16	4⅜	226	73.0 @ 2400 RPM
F244	6	3 7/16	4⅜	244	79.0 @ 2400 RPM
M271	6	3⅝	4⅜	271	86.2 @ 2400 RPM
M290	6	3¾	4⅜	290	92.2 @ 2400 RPM
M330	6	4	4⅜	330	104.4 @ 2400 RPM
M363	6	4	4 13/16	363	128.9 @ 2800 RPM
B371	6	4⅛	4⅝	371	110.0 @ 2400 RPM
B427	6	4 5/16	4⅞	427	127.0 @ 2400 RPM
*Z129	4	3¼	3⅞	129	35.0 @ 2000 RPM
*Z134	4	3 5/16	3⅞	134	39.5 @ 2000 RPM
G134	4	3⅛	4⅜	134	35.0 @ 2000 RPM
G157	4	3⅜	4⅜	157	40.0 @ 2000 RPM
*G174	4	3 5/16	4⅜	174	54.0 @ 2000 RPM
*G193	4	3¾	4⅜	193	59.4 @ 2000 RPM
*E201	4	3⅝	4⅞	201	65.9 @ 2400 RPM
*E208	4	3 11/16	4⅞	208	67.8 @ 2400 RPM
H227	4	3⅝	5½	227	54.0 @ 1800 RPM
H243	4	3¾	5½	243	57.9 @ 1800 RPM
*H260	4	3⅞	5½	260	62.0 @ 1800 RPM
*H277	4	4	5½	277	66.1 @ 1800 RPM
K363	6	4	4 13/16	363	123.0 @ 2400 RPM
*J382	4	4½	6	382	74.0 @ 1400 RPM
*U403	4	4⅝	6	403	110.0 @ 2000 RPM
T371	6	4⅛	4⅝	371	119.0 @ 2400 RPM
T427	6	4 5/16	4⅞	427	140.0 @ 2400 RPM
U501	6	4½	5¼	501	160.0 @ 2400 RPM
R513	6	4½	5⅜	513	164.3 @ 2400 RPM
R572	6	4¾	5⅜	572	182.4 @ 2400 RPM
R602	6	4⅞	5⅜	602	191.7 @ 2400 RPM
V603	8	4¾	4¼	603	240.0 @ 2800 RPM
S749	6	5⅛	5½	749	217.0 @ 2200 RPM
S820	6	5⅜	5½	820	237.0 @ 2200 RPM

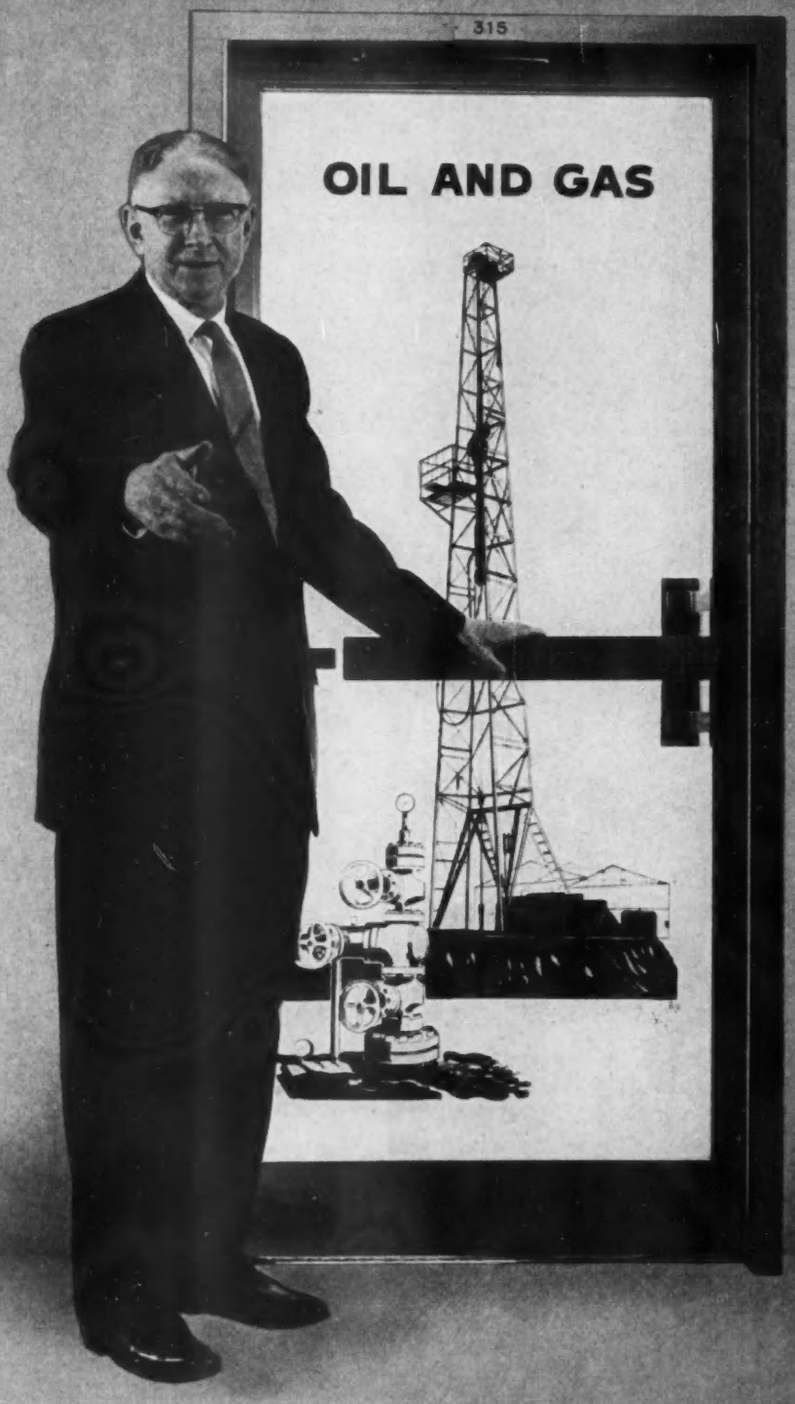
CUSHIONED POWER DIESEL ENGINES

Model	Cyl.	Bore	Stroke	Displ.	Bare Engine H.P.
*ZD129	4	3¼	3⅞	129	34.0 @ 2000 RPM
GD157	4	3⅜	4⅜	157	39.0 @ 2000 RPM
*GD174	4	3 5/16	4⅜	174	42.5 @ 2000 RPM
*GD193	4	3¾	4⅜	193	55.5 @ 2200 RPM
*ED201	4	3⅝	4⅞	201	45.8 @ 2200 RPM
*ED208	4	3 11/16	4⅞	208	61.5 @ 2200 RPM
HD243	4	3¾	5½	243	68.9 @ 2200 RPM
*HD260	4	3⅞	5½	260	74.0 @ 2400 RPM
*HD277	4	4	5½	277	79.0 @ 2400 RPM
*JD382	4	4½	6	382	87.4 @ 2000 RPM
*UD403	4	4⅝	6	403	91.5 @ 2000 RPM
TD427	6	4 5/16	4⅞	427	132.0 @ 2200 RPM
RD572	6	4¾	5⅜	572	154.0 @ 2000 RPM
VD603	8	4¾	4¼	603	197.0 @ 2600 RPM
SD802	6	5 9/16	5½	802	202.0 @ 1800 RPM

*Available for industrial applications only.

Bank of the Southwest

WELCOMES YOU, MR. OIL MAN



Harold Vance, vice president and manager, Oil & Gas Department, extends a warm welcome to you to visit the new, enlarged quarters of his department. Bank of the Southwest offers the ultimate in scope and quality of financing to the petroleum industry. The seasoned members of the Oil & Gas Department were oil men before they were bankers. A large number of our directors and advisory committee also are oil men. That's why our bank is known as the Oil Bank of the Southwest.

BANK OF THE SOUTHWEST, HOUSTON

MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

How to Curtail

BANK OF THE SOUTHWEST, HOUSTON MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

Production Expense

Cabot adjustable-crank units are made to handle polish rod loads from 7,000 to 32,000 pounds. Replacement parts and factory-trained service men are available 24 hours a day.

An example of **Cabot** pioneering is the patented tail bearing, eliminating 62 conventional parts. It requires no attention or lubrication, and dampens shocks from sucker rods. **This bearing is covered by an 8-year service policy.**

Cabot cranks are easily adjusted by one man, standing on the ground.

Cabot reducers have Sykes-cut herringbone gears in a one-piece housing. Reducer shafts require no oil seals. **Cabot reducers are covered by a 5-year service policy.**

The **Cabot** line also includes beam-balanced units for polish rod loads from 3,000 to 11,000 pounds.

The prime purpose of a **Cabot unit** is to help you minimize production costs. If you are seriously interested in curtailing production expense, you should consider **Cabot units** — NOW! Call your J&L Supply number or write us at Tulsa, P. O. Drawer 2481.

Jones & Laughlin

SUPPLY DIVISION – Tulsa

If it's sold by J&L....
It's the best available

IN TESTING TOO!

it's people who make the difference...

Even the most efficient... up-to-date, formation testing equipment is only as good as the men behind it. Uncountable numbers of potential wells have been lost and pay zones overlooked for lack of that one essential ingredient... field-proven experience.

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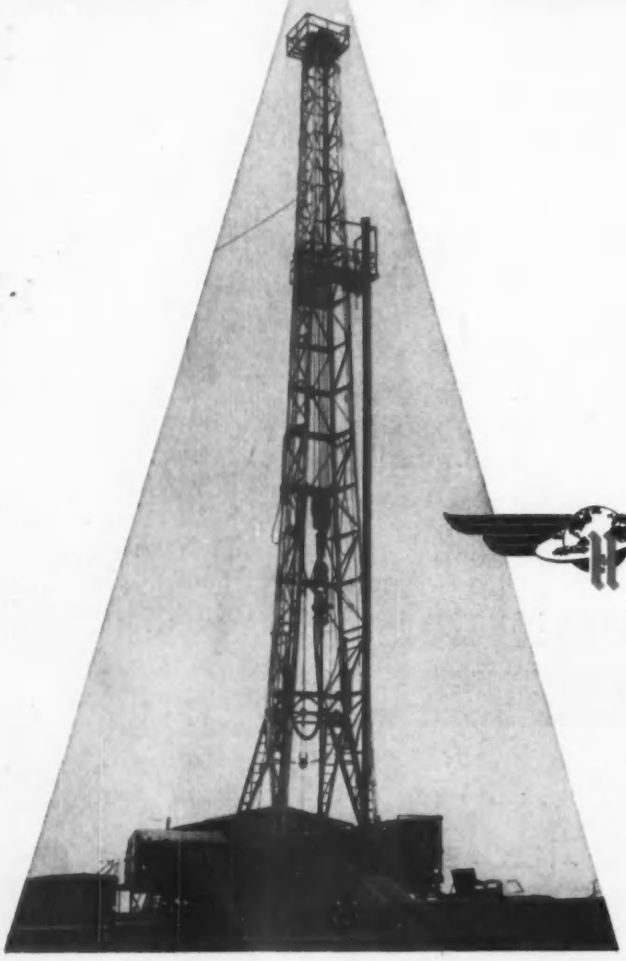


With the backing of *Halliburton knowledge and technical research of over a quarter century,* he is the best qualified, most experienced and dependable tester in the oil industry today... giving you unparalleled service.

The service that is indispensable when you must have the down-hole facts.

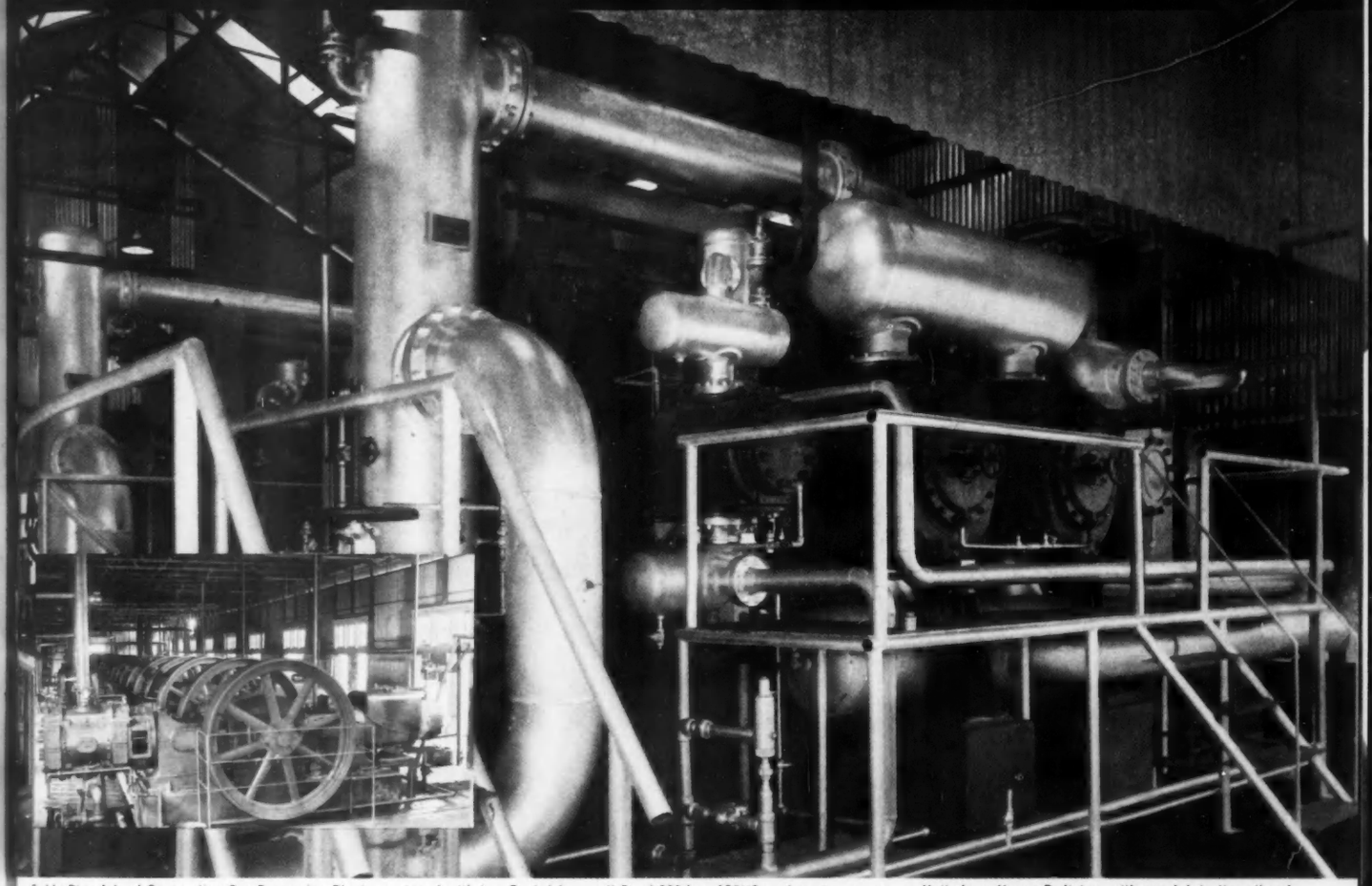
Call your Halliburton Tester, today!

HALLIBURTON OIL WELL CEMENTING COMPANY • DUNCAN, OKLAHOMA

HALLIBURTON
TESTING SERVICES

BEAIRD-INGERSOLL-RAND Packaged Compressor Plant

Lowest Cost Per Horsepower Installed



Caddo Pine Island Corporation Gas Processing Plant—equipped with two Beaird-Ingersoll-Rand 660 h.p. 12SVG packaged compressors. Units have Young Radiators with gas, lubricating oil and engine water cooling sections. Other sizes 120 to 660 h.p. Inset picture shows original horizontal compressors.

Two Packaged Compressors

DO WORK OF TWENTY OLDER UNITS

Caddo Pine Island Corporation processes flare gas from 1,000 Pine Island Field wells in an absorption plant located near Oil City, Louisiana. Picking its load up over a thirty mile gathering system, the plant was originally equipped with twenty horizontal compressor units. These have now been replaced by two Beaird-Ingersoll-Rand 12SVG 660 h. p. packaged compressors.

Using three stages of compression the packaged units pull the gas into the plant under ten inches of vacuum. It is then boosted through processing operations and returned for third stage boosting to the sales line. Up to 5¼ million cubic feet can be handled per day with final delivery pressures of 440 psi.

Installation of modern Beaird packaged compressors has increased plant dependability and lowered fuel, labor and maintenance costs. An additional savings will be realized when the field is depleted. Installation of packaged compressors has made the station almost wholly salvable.

Let Beaird engineers help you find an economical solution to your plant expansion or modernization program.

BEAIRD

another AMF product

PACKAGED COMPRESSOR PLANTS

Packaged Compressors are just one of the many products manufactured by Beaird for the petroleum and petrochemical industries. When you are in the market for new equipment or assistance in developing a specialized product . . . contact Beaird for a qualified appraisal or quotation.

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THE J. B. BEAIRD COMPANY, INC.

Shreveport, Louisiana

A Subsidiary of American Machine & Foundry Company

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BEAIRD INTERNATIONAL, INC. SHREVEPORT, LOUISIANA • *Sales Offices: Calgary, Alberta, Canada • Caracas, Venezuela.*

Du Pont High Viscosity CMC

helps you "beef up" low-solids muds

Low-solids and milk emulsion muds offer you many important benefits by increasing penetration rate, bit life, and in hurdling special problems.

But, being short on solids, these muds have to be "beefed up" to get the viscosity you need to carry cuttings out of the hole.

Low-cost way to do this is with Du Pont High Viscosity CMC, developed especially for low-solids drilling muds.

Du Pont High Viscosity CMC builds viscosity, provides good fluid loss control, and keeps your mud costs down because of the minimal amounts needed to do the job.

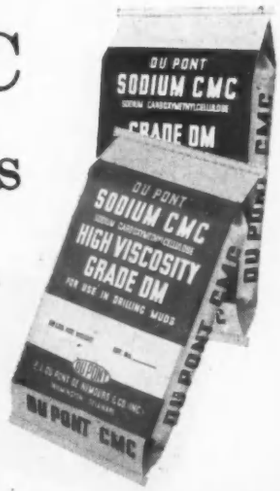
You also get excellent suspension of weight materials, high resistance to thermal and bacterial degradation, and a tough, thin filter cake with Du Pont CMC.

For low-solids muds without pain, strain, or runaway costs, call your mud dealer for immediate delivery of Du Pont High Viscosity CMC. Or get in touch with:

Barada & Page, Inc., offices in Corpus Christi, Dallas, Fort Worth, Houston, Kansas City, New Orleans, Odessa, Oklahoma City, Tulsa, Wichita.

Macco Corp., Paramount, California.

Du Pont Explosives Department, offices in Houston, Los Angeles and Wilmington. Warehouse in Farmington, New Mexico.



DU PONT CMC

DU PONT

REG. U.S. PAT. OFF.

Better Things for Better Living
. . . through Chemistry

Warning to all oilmen!

YOUR BIGGEST COMPETITOR— THE GASOLINE TAX— IS READY TO STRIKE AGAIN!

As every oilman knows, gasoline taxes are your biggest competitor for the American motorist's gasoline dollar.

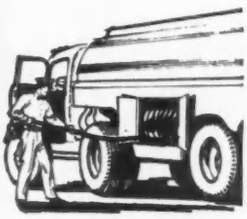
Now, according to reports from Washington, Congress will be asked to raise the federal gasoline tax again—by as much as *2¢ on every gallon!*

TODAY: The American motorist pays federal and state gasoline taxes* equal to:

41% of the retail price on every gallon

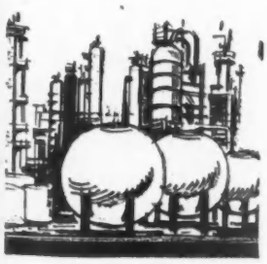
54% of the tank wagon price on every gallon

80% of the refinery price on every gallon



TOMORROW: If this tax increase is allowed to go into effect, the American motorist will pay federal and state gasoline taxes* equal to:

50% of the retail price on every gallon



66% of the tank wagon price on every gallon

97% of the refinery price on every gallon

*Combined national average of state and federal gasoline taxes.

WHAT DO YOU THINK THE AMERICAN PEOPLE WILL SAY ABOUT THIS? CAN THEY AFFORD IT? WILL THEY BLAME YOU?

COMMITTEE ON PUBLIC AFFAIRS
of the
AMERICAN PETROLEUM INSTITUTE
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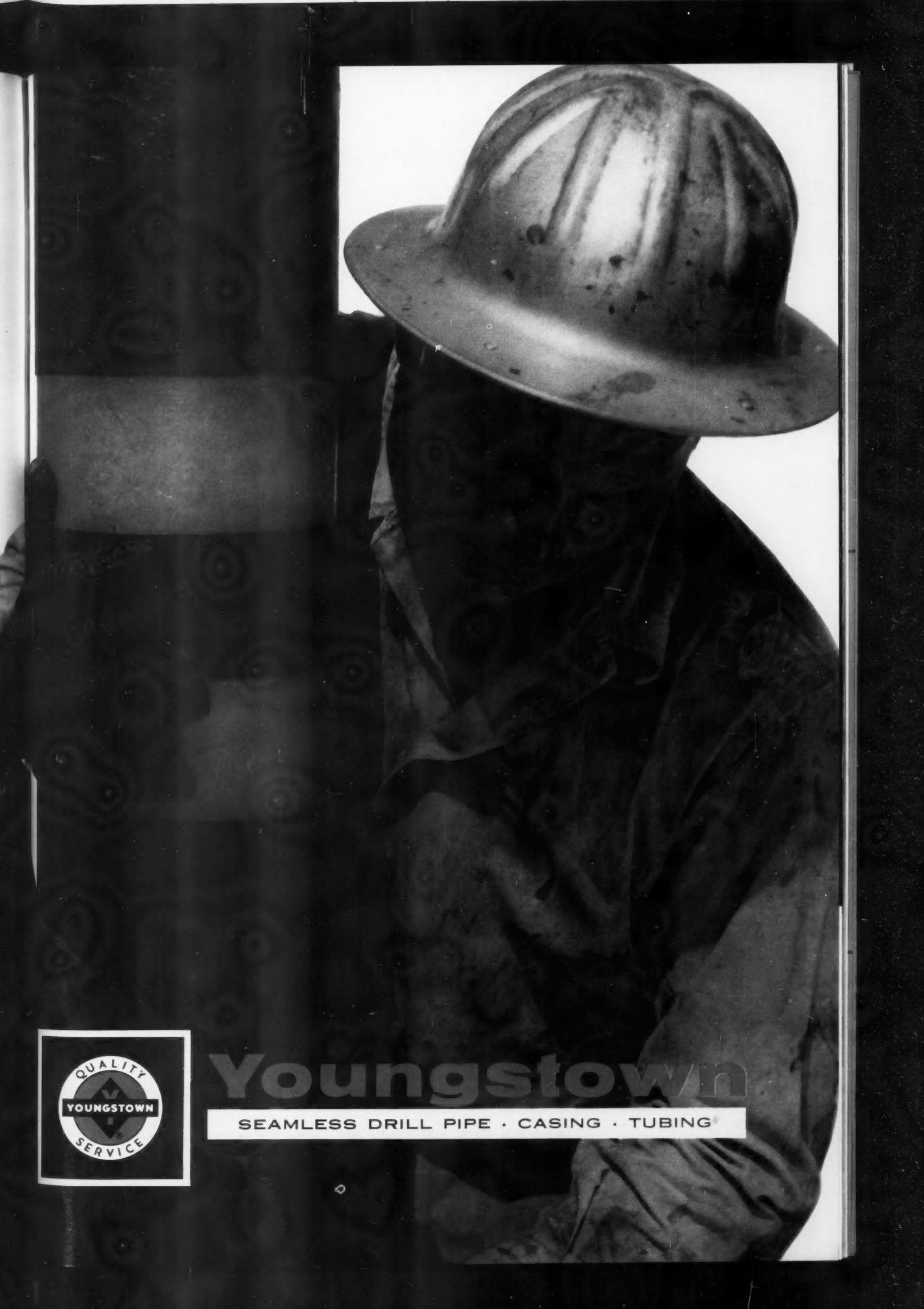
WHEREVER YOU FIND PIPE WITH ORANGE BANDS YOU'LL FIND A SMART PIPE BUYER

Youngstown's Oil Field Service Corps—nine qualified engineers—stand ready around-the-clock to consult on all your drilling problems. These professional men have offices in the oil fields and will gladly lend you their knowledge and long experience—either prior to drilling or during actual operations. They can tell you, too, about the pipe with the orange bands, the finest seamless pipe made anywhere. Call your nearest Youngstown District Office, today.

THE YOUNGSTOWN SHEET AND TUBE COMPANY

Youngstown 1, Ohio


QUALITY
YOUNGSTOWN
SERVICE
Youngstown
SEAMLESS DRILL PIPE · CASING · TUBING

Where a misstep costs $500... Blaw-Knox Electroforged® Steel Grating provides safer non-slip footing

Stair falls cost industry over $60,000,000 a year.

An average accident amounts to a loss of $500 in claims.*

A good way to guard against these profit-eating accidents is to construct your stair treads, walkways and floors with Blaw-Knox Electroforged Steel Grating. Non-slip twisted crossbars and a wide variety of bearing bars are available to meet every kind of working condition—safely solving the most hazardous skid situations.

Rigid, one-piece construction makes installation easy. Once on the job, Blaw-Knox grating practically takes care of itself. There is nothing to wear, nothing to patch, no dirt collecting corners to clean. It goes anywhere, fitting neatly around pipes, beams and machinery, admitting plenty of light and air to the area.

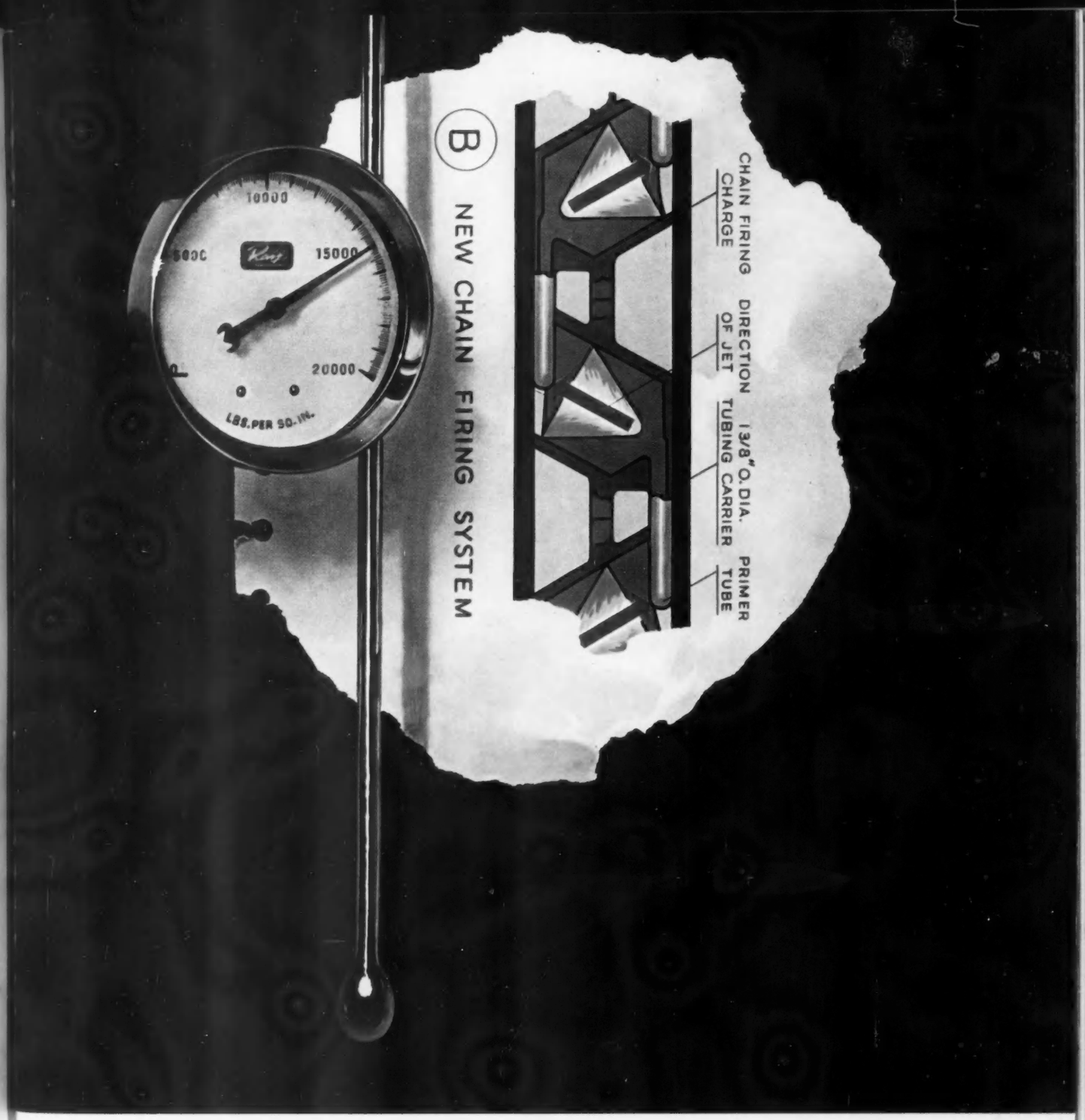
Made to your specifications, Blaw-Knox grating provides new highs in safety, easy up-keep and flexible application. For new ideas about grating—including space saving platforms and shelving, write for Bulletin 2486.

*Based on a study analyzing 803 compensable work injury claims closed in Illinois involving stairs and steps.

BLAW-KNOX

BLAW-KNOX COMPANY

Equipment Division
Dept. X, Pittsburgh 38, Pennsylvania



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All the resources and experience gained in more than 25 years in the industry are reflected in Schlumberger Perforating Services. When you call Schlumberger, you get the best—from gun design to the man on the job.

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The S-III Super Bullet Gun—leader in penetration.

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The Chain Jet—new development—without primacord—puts larger, more powerful charges in slim tubular carriers.

Safe—Efficient Operations—Performed by carefully trained engineers with the rugged Schlumberger field unit developed in more than one million service operations.

Available Everywhere—There is a Schlumberger service location in every oil-producing area.

There's no doubt about it! Schlumberger—the recognized leader in logging—leads in perforating too. Why not use the best when it costs no more?

THE EYES OF THE OIL INDUSTRY®

SCHLUMBERGER

PETROLEUM HELICOPTERS, INC. AND ALOUETTE

Petroleum Helicopters, Inc., New Orleans, La., largest U. S. helicopter operator, has successfully placed jet-powered Alouettes in regular service with its rotary-wing fleet. > > With the Alouette, Petroleum Helicopters is maintaining its reputation as a leader — providing faster, more efficient, and up-to-date equipment for its customers.*

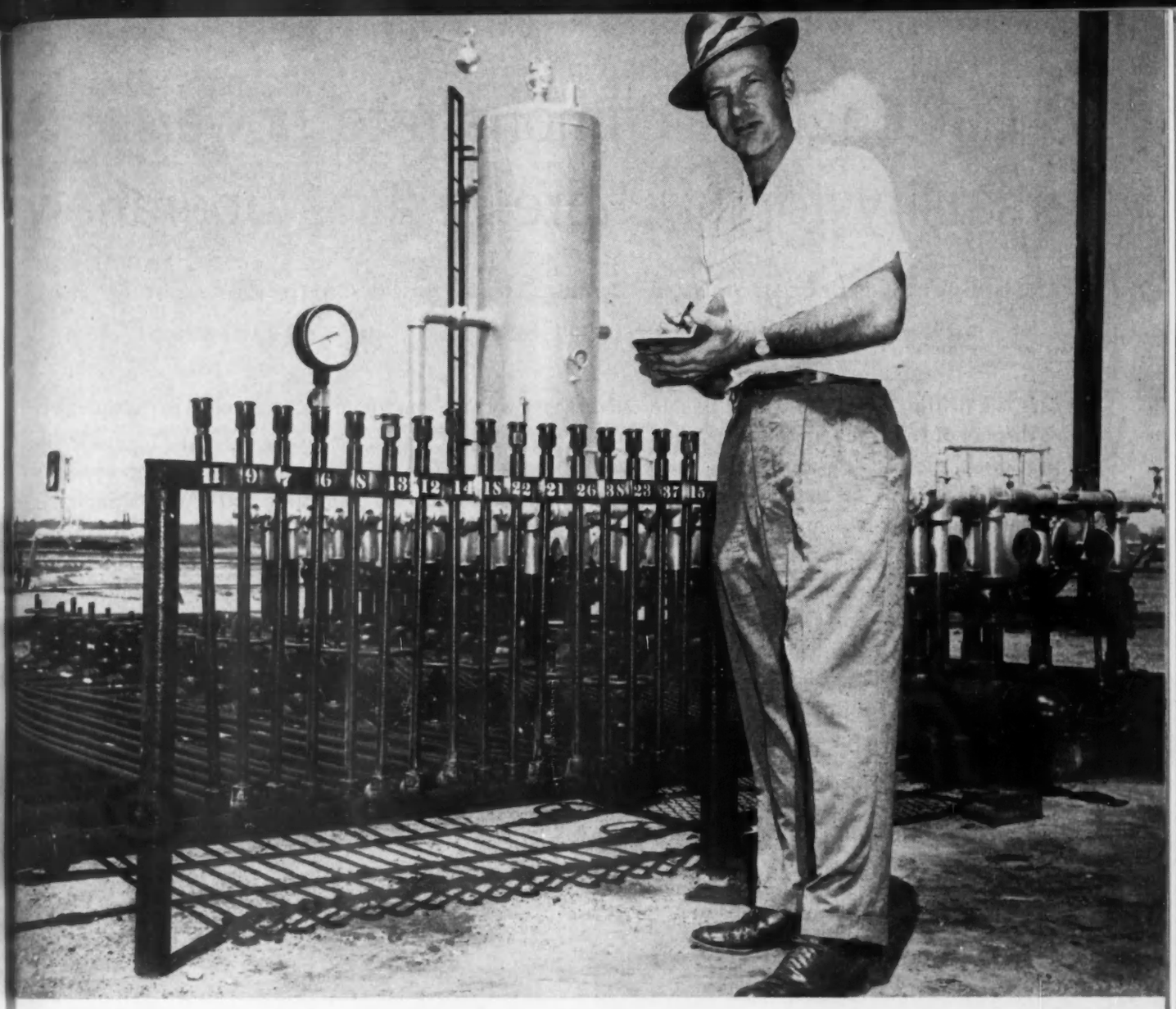
Some outstanding — yet routine — P.H.I.-Alouette operations are:

- *One Alouette flew 130 hours in 30 days covering 10,400 nautical miles.*
- *Landings and takeoffs at rigs were made in winds exceeding 35 knots.*
- *On one mission, 700 lbs. of cargo were carried 71 miles in 53 minutes (9 hours by surface craft).*
- *Saved the life of an injured oil worker — picking him up 70 miles offshore and bringing him to a hospital — when time meant life!*

**Designed by Sud Aviation*

The Alouette is assembled, tested and distributed by:

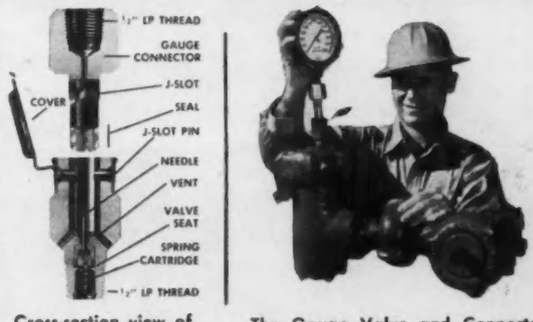
REPUBLIC AVIATION CORPORATION
HELICOPTER DIVISION
FARMINGDALE, LONG ISLAND, N. Y.



You Can Stand In One Spot And Gauge Sixteen Wells . . . With One Pressure Gauge . . . in 10 minutes!

It's no trick, and you can do it. Pictured above is a 16-well manifold at a central lease tank battery. Instead of separate pressure gauges for each well, the manifold is equipped with T-C Gauge Valves. A single pressure gauge, with a T-C Connector attached, is stabbed into each Gauge Valve to obtain a pressure reading. Just insert the connector in the valve, rotate 45 degrees, the valve opens automatically, and that's all.

For individual wells, instead of installing permanent gauges on tubing and casing, many operators are now using T-C Gauge Valves and Connectors. The first cost is lower, there's no gauge breakage—gauge repair costs are eliminated—and since the gauges are not exposed to the elements, you can be sure of accurate pressure readings.



Cross-section view of Gauge Valve and Connector.

The Gauge Valve and Connector is widely used on Christmas trees.

THORNHILL CRAVER CO.

P. O. Box 1184, Houston, Texas

18 Cat Engines demonstrate power and versatility for offshore drilling operation

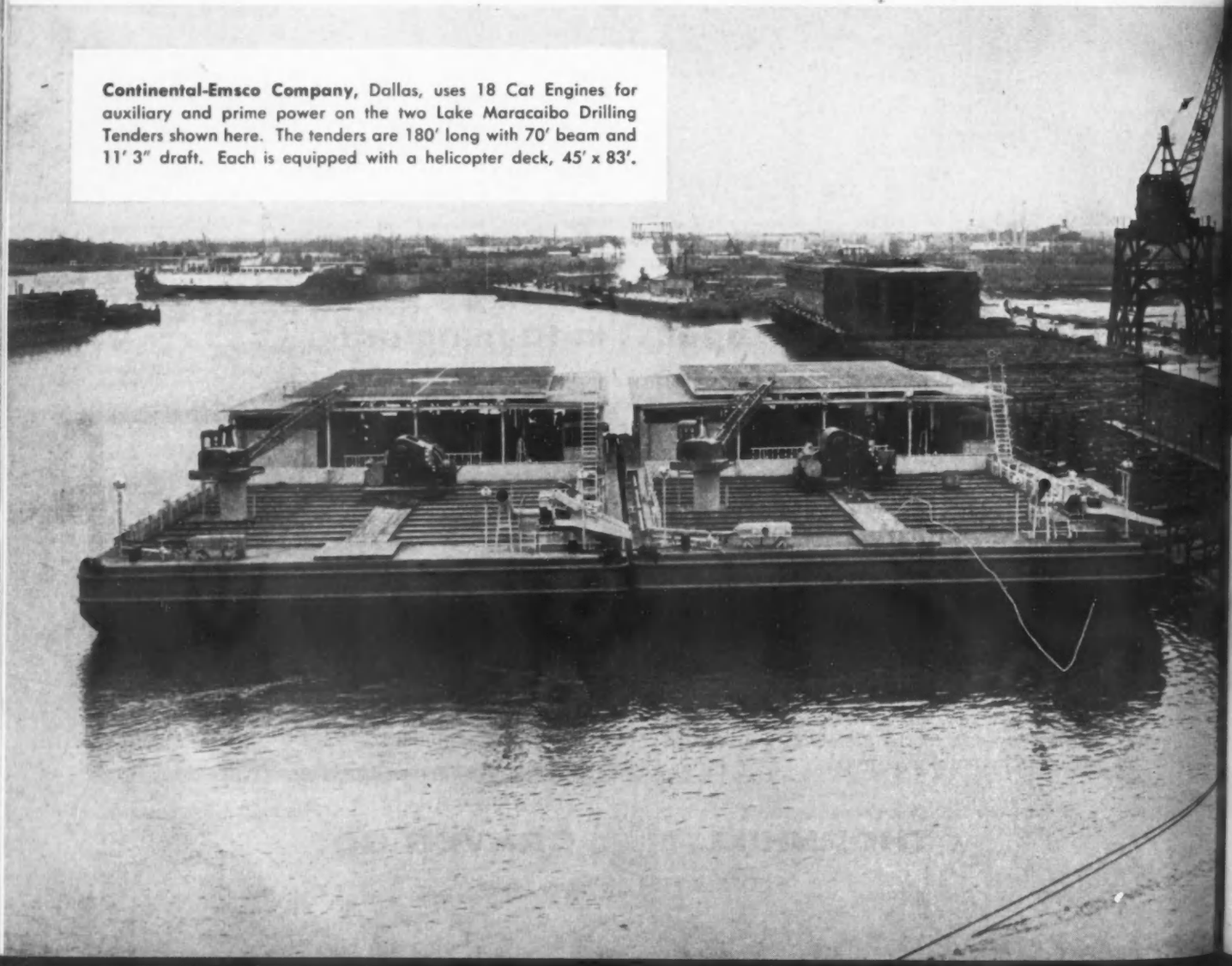
Continental-Emsco Company, Dallas, Texas, used Cat power right up the ladder—from the compact D311 to the mighty D397 Engines.

If yours is a drilling operation, you'll be interested in this display of versatile Caterpillar power. From compact diesel electric sets to modern, heavy-duty diesel engines, there's a Cat unit power-right for your needs, either as a complete package or for special installations.

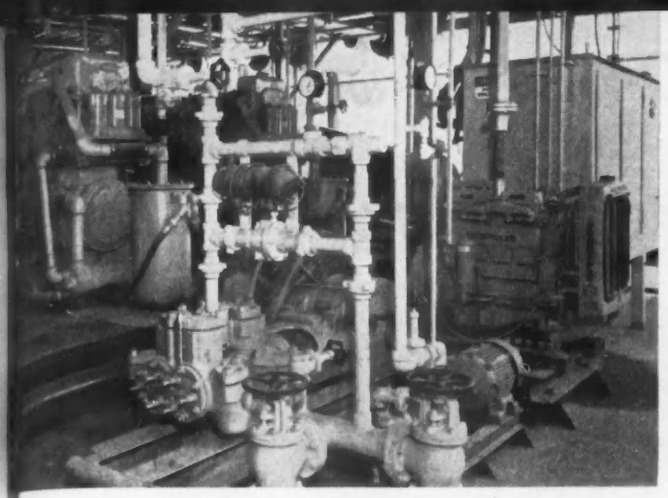
Continental-Emsco recognized that Cat power makes good sense and used Caterpillar Engines for the Lake Maracaibo Drilling Tenders they build for "in stock" delivery. C-E knew that easy accessibility and interchangeability of parts, as well as dependable, 'round-the-clock service, mean less down time and lower operating costs to the operator.

Your Caterpillar Dealer has Cat Engines available from 65 to 650 HP (maximum output capacity) and Electric Sets from 30 to 350 KW (continuous). And a Cat Engine Specialist will be glad to discuss your operation with you. Get in touch, today. He's as near as your telephone. Remember, too, when you order oilfield equipment, specify the power that's matched to the heavy-duty equipment . . . always specify Caterpillar.

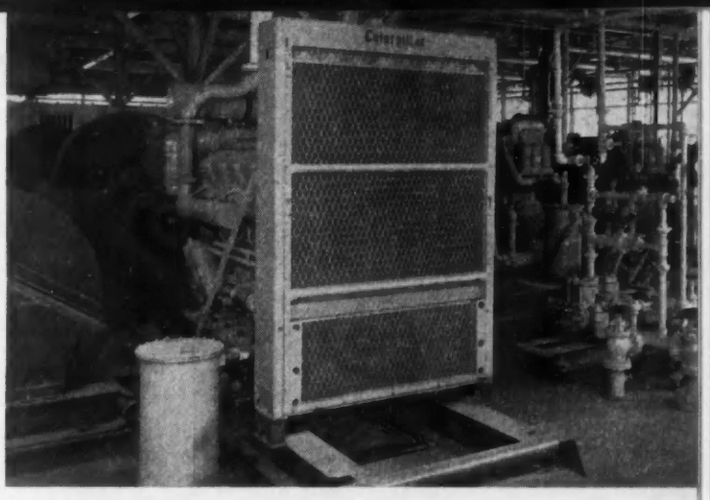
Engine Division, Caterpillar Tractor Co., Peoria, Ill., U. S. A. Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.



Continental-Emsco Company, Dallas, uses 18 Cat Engines for auxiliary and prime power on the two Lake Maracaibo Drilling Tenders shown here. The tenders are 180' long with 70' beam and 11' 3" draft. Each is equipped with a helicopter deck, 45' x 83'.

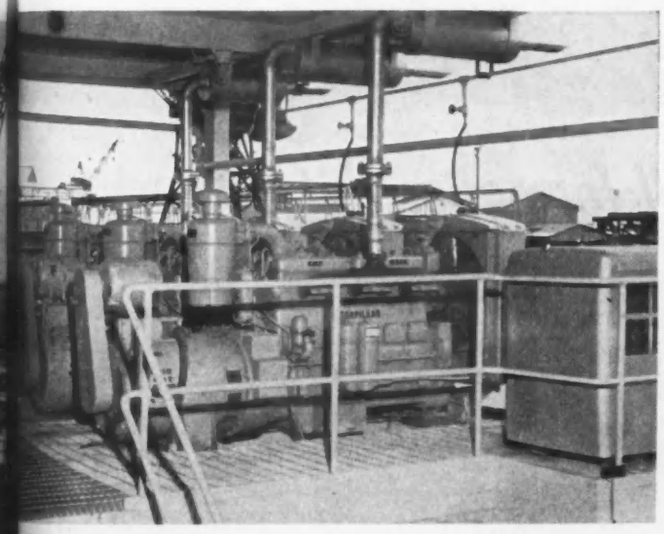


A modern, heavy-duty Cat D311 Engine (right) drives a Gardner-Denver FG-FXG 5" x 6" pump on each tender. These Cat-powered duplex pumps supply raw water for washing down rigs and keeping tenders clean.

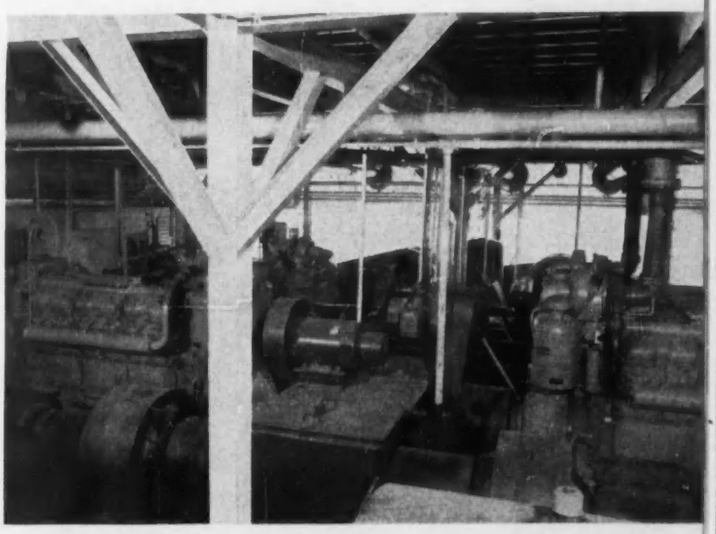


Here a Caterpillar Diesel D375 Engine supplies power for a Gardner-Denver mud pump on each tender. Continental-Emsco Company finds the D375 an excellent power-match for the 7¼" x 14" Model FK-FXK pump.

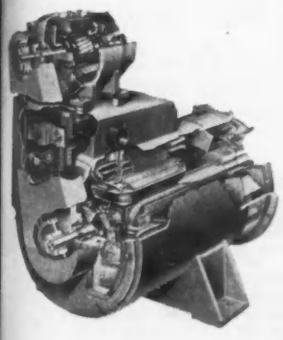
ENGINE POWER BY CATERPILLAR



Three Cat D318 Diesel Electric Sets provide all A.C. electric power for each tender. Uses include excitation for the D.C. rig drive equipment, the generator and motor blowers, mud mixers, water and fuel pumps, and lighting for rig and living quarters.



Four turbocharged Cat D397 Diesel Engines drive Continental-Emsco "Del Lago" type compounding transmissions on each tender. The rigs, intended for service on Lake Maracaibo, Venezuela, have a drilling depth of 12,000 to 15,000 feet.



Modern, heavy-duty Cat Generator: Offering the best features of self-regulated and externally regulated units, the advanced-design Cat Generator has no moving parts in the regulator. Voltage is adjustable from 5% above to 10% below nominal voltage. It affords excellent motor starting ability and it is power-matched to the engine, maintaining steady voltage from no load to full. A heavy-duty, easily lubricated bearing and a well-insulated rotor assembly assure long life and continuous output.

Engine Division, Dept. WO12
CATERPILLAR TRACTOR CO., Peoria, Illinois, U. S. A.

Send me more information about Cat Diesel Engines and Electric Sets for drilling.

☐ Have Caterpillar Dealer call for an appointment as I may be in the market. I understand that I am under no obligation.

☐ Send me more information in general about these engines.

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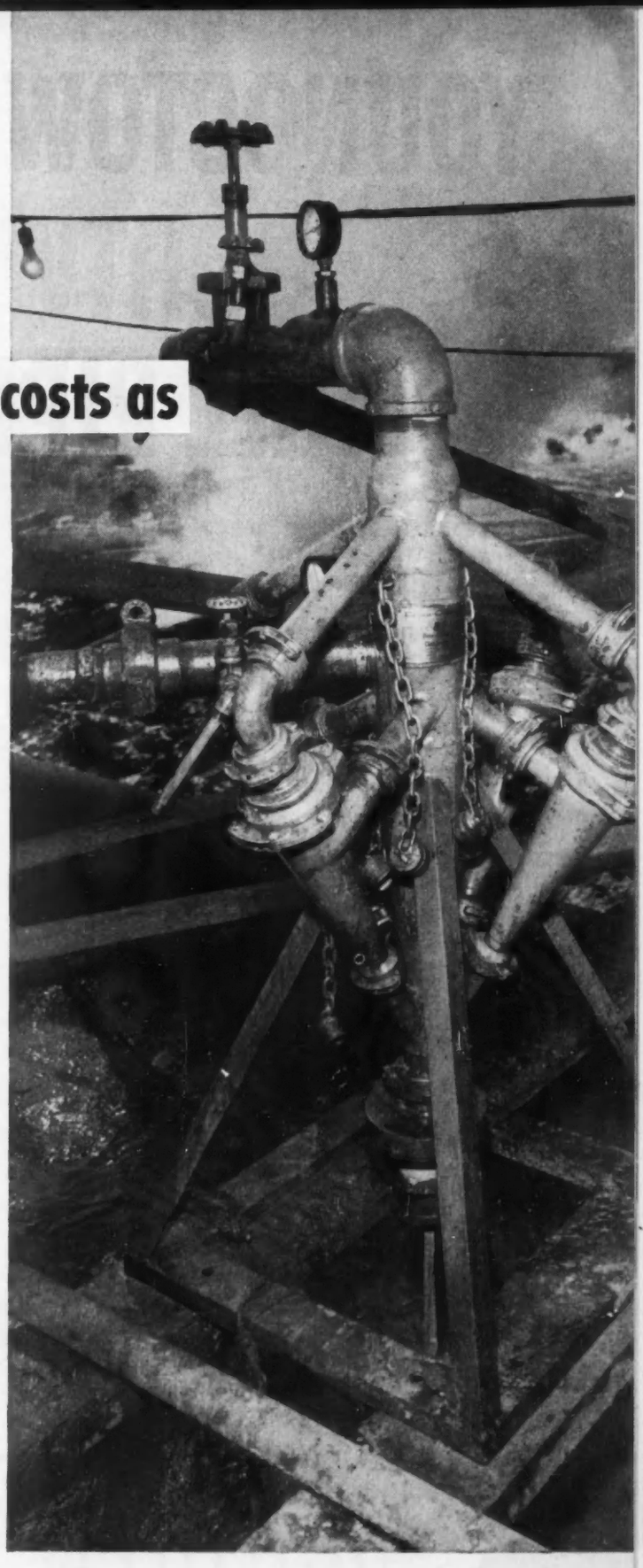


Cut mud maintenance costs as much as 60% with the CLAYJECTOR

If you are drilling deep wells with heavily weighted muds you may be able to cut mud maintenance costs by as much as 60 per cent if you use the CLAYJECTOR* to recover barite and remove drilled solids. In actual tests, savings of over $1,000 per day have been obtained.

When drilling shallower wells using lighter muds the CLAYJECTOR can make smaller—but still important—savings. It should be considered whenever mud weight exceeds 11.5 pounds per gallon and it will definitely save money whenever 60 or more sacks of weighting material per day are required to maintain the mud.

Other advantages include faster drilling and greater safety that result from closer control of mud characteristics.

The CLAYJECTOR is a four-cyclone drilling mud separator with a simple, easy-to-control feed and dilution unit. It is trouble-free and easy to operate. It is easy to move and install. Furthermore, rental costs are so reasonable that it can be used profitably on many wells where it would be impractical to use more elaborate units.

Extremely high clay-rejection efficiency (averaging about 75 per cent) and high barite recovery (85 to 90 per cent) account for the unusual effectiveness of the CLAYJECTOR. Since a minimum volume of mud need be processed for a given clay rejection, chemical and barite losses are kept to a minimum.

The CLAYJECTOR is engineered, distributed and serviced by Salt Water Control, Inc. It is available on either a rental or lease basis.

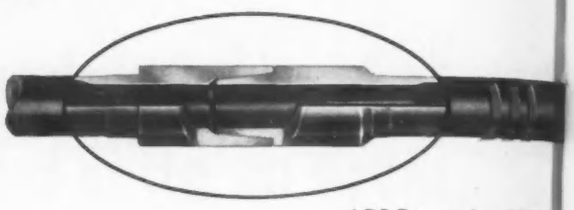
Here is a unit especially tailored to the requirements of drilling contractors. For more information, call on your nearest SWACO representative or write us in Fort Worth.

**CLAYJECTOR is a registered trademark of Dorr-Oliver, Inc., Stamford, Connecticut.*

SWACO SALT WATER CONTROL, Inc.

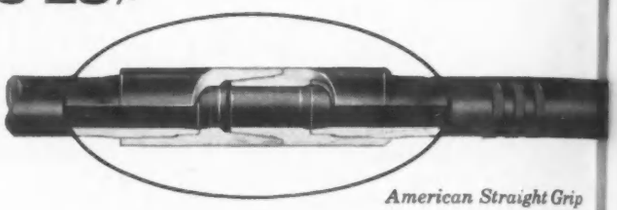
1809 Continental National Bank Bldg. Phone: ED 2-4434 Ft. Worth 2, Texas

YOUNGSTOWN LIGHTWEIGHT DRILL PIPE



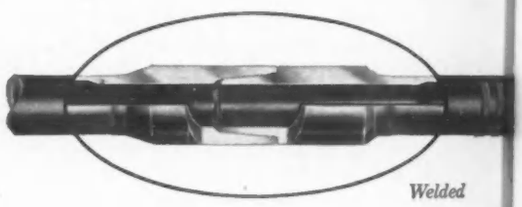
API Counter-bore Weld

Extends drilling depth, reduces hoisting loads 25% —with your present rig



American Straight Grip

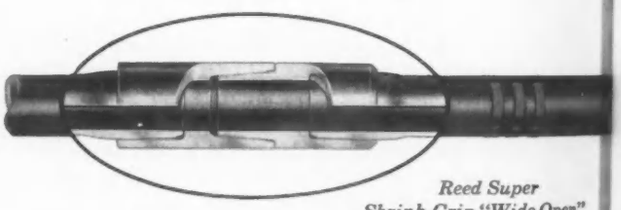
Now, Youngstown provides a lightweight drill pipe that will substantially extend your bidding range. You can bid and *get* those deeper drilling contracts—without any changes in your present rig.



Welded

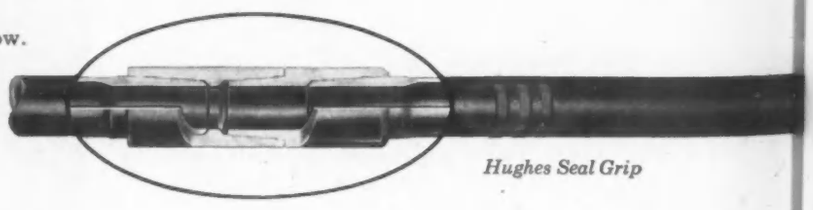
You get more rotating hours with this Orange Band pipe. From ore through final inspection, it is manufactured to rigid drill pipe specifications . . . not a tubing substitute.

On a 10,000-foot hole, a string of 4½″ lightweight drill pipe is 14¼ tons lighter than 4½″ regular drill pipe—because it's 2.85 pounds lighter per lineal foot. This means longer drill strings *without increased weight.*



Reed Super Shrink-Grip "Wide Open"

Since a larger ID is used, hydraulic efficiency (on a 10,000-foot string, 16.7% less pressure drop in drilling fluid column) is improved for longer slush pump rod and bearing life . . . plus a lowering of horsepower requirements.



Hughes Seal Grip

Get those additional contracts now. See your Youngstown man today for the complete story on the pipe with the Orange Bands—or write direct to our Home Office for additional information.

The Youngstown Sheet and Tube Company
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Youngstown Lightweight Drill Pipe
Is Available Threaded or Plain End, Internal or External Upset for Attachment with Above Tool Joints.

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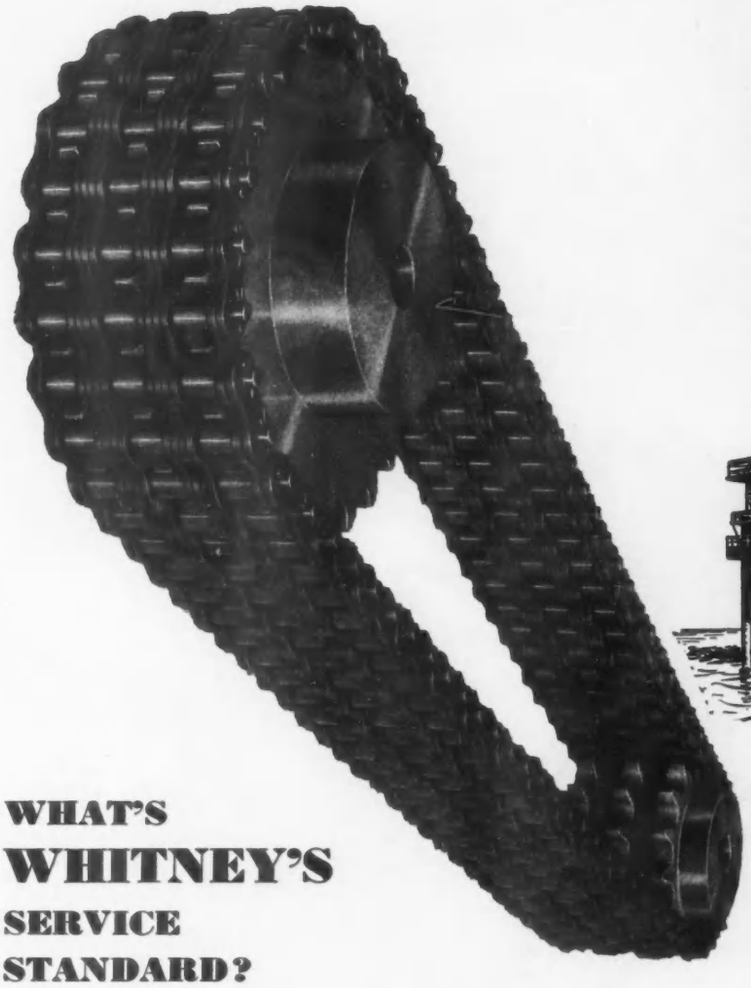

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It's important to you as a producing man.

Whitney Chain designs and engineers to one objective . . . to provide maximum chain performance *on the rig* where production pays off. This is backed up by more than 40 years of successful service on top oil field jobs everywhere.

Today . . . Whitney brings you *fatigue resistant* Processed Roller Chain featuring time and money saving *"FLUID-FIT"* Assembly. This design advance gives you maximum *durability plus* fast, easy chain *assembly* or *adjustments* anywhere . . . on the rig—in the shop—at the supply store.

Take these features individually. Whitney's *fatigue resistant* Process is establishing new service life standards, particularly on "problem" drives involving stresses and heavy shock loads. Here, Whitney's exclusive *fatigue resistant* Process offsets excessive operational stresses in the chain . . . assures better, longer service.

Combined with this is *"FLUID-FIT"* Assembly. This Whitney design features all-cottered chain construction with slip-fit link assemblies. *"FLUID-FIT"* gives you effortless, rapid chain assembly or adjustments . . . no tough repair work, no time wasting delays in repairing or replacing chain.

And still more service—Whitney factory packaging protects chain and parts against dust, dirt and moisture, each item clearly labeled for quick, sure identification. Whitney operates company staffed, completely stocked oil country warehouses in Dallas, Texas and Los Angeles, California and provides off-the-shelf service through oil field supply stores located in every producing area.

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However, continuous probing beneath the earth's surface depends on how much punishment tubular materials can stand. They must be worked hard and deep. They must resist twisting action, fatigue and collapse. And they must be ready to meet the more rigid stresses of deeper drilling tomorrow. You can bet when new records are set USS National Seamless Oil Country Tubular Products will be on the job. They are acknowledged the world over as the most ideal materials for deep well work because their strength and dependability can be attributed to two vital factors—quality steel and a unique way of manufacture. Each seamless tube is pierced from a solid billet of steel. And only steel of the very best forging properties and of the highest uniformity can be used, since the modern piercing operation tends to search out any defects in the metal.

For drill pipe, casing and tubing that can really "take it"—products that will consistently give you the most service per dollar invested—remember to specify USS National Seamless Oil Country Tubular Products . . . every time!

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General Electric Announces the All-new Type KOF Motor—Only Known Motor with Electrical Characteristics Designed Specifically for Oil Well Pumping

NEW DESIGN GIVES 8 TO 10 PERCENT SLIP, 400 PERCENT STARTING TORQUE, LOWER KWH PER BARREL

General Electric's new oil well pump motor — the Type KOF — features new electrical characteristics specially designed to meet the unusual demands of an oil rig's highly cyclic load. Highest slip—8 to 10 percent—and highest starting torque—400 percent—of any available oil well pumping motor, smooth out pulsating load peaks and overcome unusual loads.

Now you can select a motor designed *specifically* to provide optimum performance and economy on oil well pumping applications. For the full story of this new motor development, contact your nearby Apparatus Sales Office or distributor: or write direct to Section 899-3, General Electric Company, Schenectady 5, N. Y.

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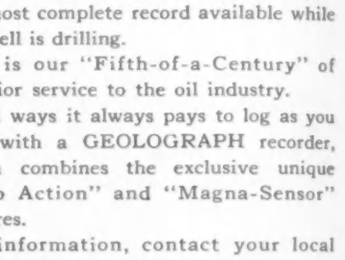
RECLAIM TANK BOTTOMS with BrakeSol



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For more data on New Equipment or copies of Catalogs and Literature reviewed in this issue, use the Reader's Service postcards just inside the back cover and facing the Advertisers Index. Simply circle code numbers of items desired—sign and mail card. Requests are transmitted to the manufacturer as soon as received by us for mailing of desired information directly to you.

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A four-page folder has been issued showing easier and more effective use of engineering drawings with the introduction Photoneering, a new process that combines photography and drawing.

Specifications can be drawn directly on a photograph taken from any angle or point of perspective. A special heat and humidity resistant plastic film sheet is used, which permits necessary changes or erasures.

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Explosive Valve Manual

Conax explosive valve catalog is available from Conax Corporation.

This new 16-page catalog fully describes and illustrates the complete standard line and typical specials of Conax explosive valves, Conax explosive latch pins, Conax explosive actuators and Conax thermocouples and pressure sealing assemblies.

To get a copy, circle **No. E25** on Readers' Service Card, last page this issue.

Descriptive Pamphlet

Cardwell Manufacturing Company's servicing hoists, draw works, masts and mud pump equipment are described in detail in a new 60-page reprint section, taken from the 1958 World Oil Composite Catalog. All servicing hoists, draw works, self-propelled "Travelrigs," masts and mud pumps are illustrated. Detailed charts on line speed and pulls, drum capacities, performance and dimensions are included.

To get a copy, circle **No. E26** on Readers' Service Card, last page this issue.

Expansion Joint Book

The Expansion Joint Manufacturers Association has released an edition of expansion joint standards. This edition contains up-to-date information concerning the design, construction, application and testing of expansion joints for piping and other services.

To get a copy, circle **No. E27** on Readers' Service Card, last page this issue.

Phase Conversion Folder

Ken Elliott Motors, Inc., have made available a data file giving complete information on the H-A-S Phase Conversion System which is especially suitable for oil well pumping installations in those cases where only single phase current is available.

To get a copy, circle **No. E28** on Readers' Service Card, last page this issue.

Pesticides Brochure

"Your Ready-Reference Guide to Dependable Diamond Weed and Brush Killers for Effective, Easy, Economical Weed and Brush Control" is the title of an illustrated, 12-page booklet issued by Diamond Alkali Company.

To get a copy, circle **No. E29** on Readers' Service Card, last page this issue.

Coupling Handbook

Snap-Tite, Inc. has issued a new general catalog describing the company's standard line of quick-connect, quick-disconnect couplings. The five basic Snap-Tite couplings shown include the "H" coupling for high pressure applications; the "IH" coupling for impact in air lines; the Hi-Flow coupling for low pressure applications; the "E" coupling for vacuum and very low pressures; and, the "T" coupling for hard to handle fluids.

To get a copy, circle **No. E30** on Readers' Service Card, last page this issue.

Company Services Catalog

Dowell Incorporated has prepared two new brochures detailing complete services offered by the company. The first is a complete catalog of Dowell Services and Products consisting of 19 pages fully illustrated. The other brochure entitled "Packaged Products for Industry" details technical information on application of Dowell products. This book contains information supplemented with photos and curves.

To get a copy, circle **No. E31** on Readers' Service Card, last page this issue.

Needle Valve Pamphlet

Bulletins detailing stainless steel bodies seat-seal and needle valves manufactured by Grove Valve and Regulator Company are now available. The Grove Series "T" (seat-seal) and Series "N" (needle) valves have application in the oil and gas industry where ease of operation and bubble-tight shutoff are essential.

To get a copy, circle **No. E32** on Readers' Service Card, last page this issue.

Chemical Bulletin

A comprehensive bulletin recently published by the BJ Service, reviews each acid treating solution, chemical blocking agent and auxiliary chemical service offered by BJ for well stimulation. The bulletin includes a discussion of the composition, purpose and action of each chemical formulation, together with charts and a glossary of terms used in chemical well-stimulation work.

To get a copy, circle **No. E33** on Readers' Service Card, last page this issue.

Screen Pipe Catalog

An eight-page catalog describing screen pipe for oil, gas and water wells, including the "more area" slotted screen pipe, vertical slotted and drilled hole wire wrapped screen, ribbed type wire wrapped screen and prepacked gravel pack screen, together with specifications of various types, is available from the Emsco Screen Pipe Company.

To get a copy, circle **No. E34** on Readers' Service Card, last page this issue.

Midget Valve Booklet

High Pressure Equipment Company has issued a catalog describing in detail the company's full line of midget valves and fittings, which offer a wide range of mechanical seals and controls.

The units are used to provide minimum capacity in capillary and small diameter high pressure tubing systems.

To get a copy, circle **No. E35** on Readers' Service Card, last page this issue.

Blowout Preventer Catalog

A 20-page catalog has been made available by Stewart & Stevenson Distributing Co., featuring Koomey Blowout Preventer Operating and Testing Units. The catalog —complete with illustrations, photographs, diagrams, charts and equations—contains complete information on one of the most important pieces of rig equipment, the blowout preventer operating unit.

To get a copy, circle **No. E36** on Readers' Service Card, last page this issue.

Standards Revisions

Two revisions of American Standards—B16.9-1958 steel butt-welding fittings and B16.25-1958 butt-welding ends—have been approved by the American Standards Association and published by The American Society of Mechanical Engineers.

Both standards are sponsored jointly by the Mechanical Contractors Association of America, the Manufacturers Standardization Society of the Valve and Fittings Industry and The American Society of Mechanical Engineers.

To get a copy, circle **No. E37** on Readers' Service Card, last page this issue.

Condensed General Catalog

Rolo Manufacturing Company has made available Catalog 58G, as useful information on Rolo's line of oil meters, standard and high capacity metering separators, automatic custody transfer units, calcium chloride gas dehydrators and other products.

To get a copy, circle **No. E38** on Readers' Service Card, last page this issue.

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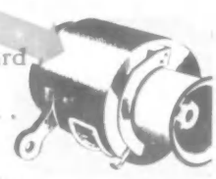

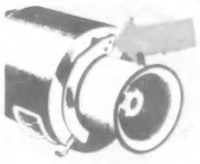

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1958 WORLD OIL

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